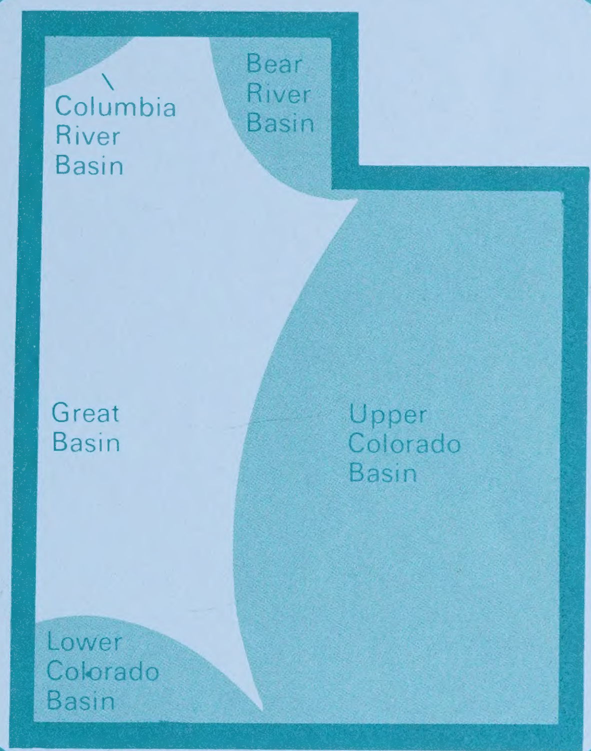


# DEVELOPING A STATE WATER PLAN

## GROUND-WATER CONDITIONS IN UTAH, SPRING OF 1987

Cooperative Investigations Report No. 27



Utah Division of Water Resources — U.S. Geological Survey

DEVELOPING A STATE WATER PLAN

# GROUND-WATER CONDITIONS IN UTAH, SPRING OF 1987

by

Dale E. Wilberg and others

United States Geological Survey



Prepared by the United States Geological Survey
in cooperation with the State of Utah

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## CONVERSION FACTORS

Most values in this report are given in inch-pound units. Conversion factors to metric units are shown below.

| Multiply | By | To obtain |
|---|---|---|
| Acre-foot | 1233 | Cubic meter |
| Foot | 0.3048 | Meter |
| Inch | 25.40 | Millimeter |
| Mile | 1.609 | Kilometer |

Chemical concentration is given only in metric units—milligrams per liter. For concentrations less than 7,000 milligrams per liter, the numerical value is about the same as for concentrations in parts per million.

# GROUND-WATER CONDITIONS IN UTAH, SPRING OF 1987

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U.S. Geological Survey

## INTRODUCTION

This is the twenty-fourth in a series of annual reports that describe ground-water conditions in Utah. Reports in the series, prepared cooperatively by the U.S. Geological Survey and the Utah Division of Water Resources, provide data to enable interested parties to keep abreast of changing ground-water conditions.

This report, like the others in the series, contains information on well construction, ground-water withdrawals from wells, water-level changes, and related changes in precipitation and streamflow. Supplementary data such as graphs showing chemical quality of water and maps showing water-level contours are included in reports of this series only for those years or areas for which applicable data are available and are important to a discussion of changing ground-water conditions.

The report includes individual discussions of selected major areas of ground-water development in the State for the calendar year 1986. Water-level fluctuations, however, are described for spring 1986 to spring 1987. Much of the data used in the report were collected by the Geological Survey in cooperation with the Division of Water Rights, Utah Department of Natural Resources.

The following reports dealing with ground water in the State were released or printed by the Geological Survey during 1986:

Ground-water conditions in Utah, spring of 1986, James L. Mason and others, Utah Division of Water Resources Cooperative Investigations Report 26.

Seepage studies of the Weber River and the Davis-Weber and Ogden Valley Canals, Davis and Weber Counties, Utah, 1985, L. R. Herbert, R. W. Cruff, D. W. Clark, and Charles Avery, Utah Department of Natural Resources Technical Publication No. 90.

Ground-water conditions in Salt Lake Valley, 1969-83, and predicted effects of increased withdrawals from wells, K. M. Waddell, R. L. Seiler, Melissa Santini, and D. K. Solomon, Utah Department of Natural Resources Technical Publication No. 87.

Selected hydrologic and physical properties of Mesozoic formations in the Upper Colorado River Basin in Arizona, Colorado, Utah, and Wyoming--Excluding the San Juan Basin, Jay F. Weigel, U.S. Geological Survey Water-Resources Investigations Report 86-4170 (in press).

Chemical quality of ground water in Salt Lake Valley, Utah, 1969-85, K. M. Waddell, R. L. Seiler, and D. K. Solomon, Utah Department of Natural Resources Technical Publication No. 89 (in press).

Selected hydrologic data from wells in the East Shore area of the Great Salt Lake, Utah, 1985, G. G. Plantz and others, U.S. Geological Survey Hydrologic-Data Report 45.

Program for monitoring the chemical quality of ground water in Utah--Summary of data collected through 1984, Don Price and Ted Arnow, Utah Department of Natural Resources Technical Publication No. 88.

Ground-water conditions in the Kaiparowits Plateau area, Utah and Arizona, with emphasis on the Navajo Sandstone, Paul J. Blanchard, Utah Department of Natural Resources Technical Publication No. 81.

Ground-water conditions in the Lake Powell area, Utah, Paul J. Blanchard, Utah Department of Natural Resources Technical Publication No. 84.

Water resources of the Park City area, Utah, with emphasis on ground water, Walter F. Holmes, Kendall R. Thompson, and Michael Enright, Utah Department of Natural Resources Technical Publication No. 85.

Bedrock aquifers of Eastern San Juan County, Utah, Charles Avery, Utah Department of Natural Resources Technical Publication No. 86.

Selected hydrologic data for Salt Lake Valley, Utah, October 1968 to October 1985, R. L. Seiler, U.S. Geological Survey Hydrologic-Data Report No. 44.

Guide to user modification of a three-dimensional digital ground-water model for Salt Lake Valley, Utah, R. L. Seiler and K. M. Waddell, U.S. Geological Survey Open-File Report No. 86-307.

Ground water in Utah's densely populated Wasatch Front area—the challenge and the choices, Don Price, U.S. Geological Survey Water-Supply Paper 2232.

Hydrology of the Price River basin, Utah, with emphasis on selected coal-field areas, K. M. Waddell, J. E. Dodge, D. W. Darby, and S. M. Theobald, U.S. Geological Survey Water-Supply Paper 2246.

## UTAH'S GROUND-WATER RESERVOIRS

Small quantities of ground water can be obtained from wells throughout much of Utah, but large supplies that are of suitable chemical quality for irrigation, public supply, or industrial use generally can be obtained only in specific areas. The major areas of ground-water development discussed in this report are shown in figure 1 and named in table 1. Relatively few wells outside of these areas yield large supplies of water of good chemical quality for the uses listed above, although some of the basins in western Utah and many areas in eastern Utah have not been explored sufficiently to determine their potential for ground-water development.

About 2 percent of the wells in Utah obtain water from consolidated rocks. The consolidated rocks that yield the most water are lava flows, such as basalt, which contain interconnected vesicular openings or fractures or permeable weathered zones at the tops of flows; limestone, which contains fractures or other openings enlarged by solution; and sandstone, which contains open fractures. Most of the wells that tap consolidated rocks are in the eastern and southern parts of the State in areas where water supplies cannot be obtained readily from unconsolidated deposits.

About 98 percent of the wells in Utah draw water from unconsolidated deposits. These deposits may consist of boulders, gravel, sand, silt, or clay, or a mixture of some or all of these materials. Wells obtain the largest yields from the coarser materials that are sorted into deposits of uniform grain size. Most wells that tap unconsolidated deposits are in large intermountain basins, which have been partly filled with rock material eroded from the adjacent mountains.

## SUMMARY OF CONDITIONS

The estimated total withdrawal of water from wells in Utah during 1986 was about 688,000 acre-feet, which is about 51,000 acre-feet less than the revised estimate for 1985 and about 91,000 acre-feet less than the average annual withdrawal for 1976-85 (table 2). The majority of the decrease in withdrawal was due to a decrease in withdrawal for irrigation. Withdrawal for irrigation was 393,000 acre-feet (table 2), which is 34,000 acre-feet less than the estimate for 1985. Withdrawal for industry was 71,000 acre-feet, which is 14,000 acre-feet less than the revised estimate for 1985. Total withdrawal for public supply was 160,000 acre-feet, which is the same as the revised estimate for 1985. Withdrawal for domestic and stock use was 64,000 acre-feet, which is 2,000 acre-feet less than the revised estimate for 1985.

The quantity of water withdrawn from wells is related to demand and availability of water from other sources, which in turn is related to local climatic conditions. Of the 33 weather stations that are included in this report with graphs or bar charts showing cumulative departure from average-annual precipitation, 7 stations recorded below the average annual amount, in contrast to the 0 to 5 stations that recorded below-average precipitation during 1982-84 and the 9 stations that recorded below-average precipitation in 1985. This was the fifth consecutive year of generally above-average precipitation in Utah. The largest positive departures, more than 5 inches above

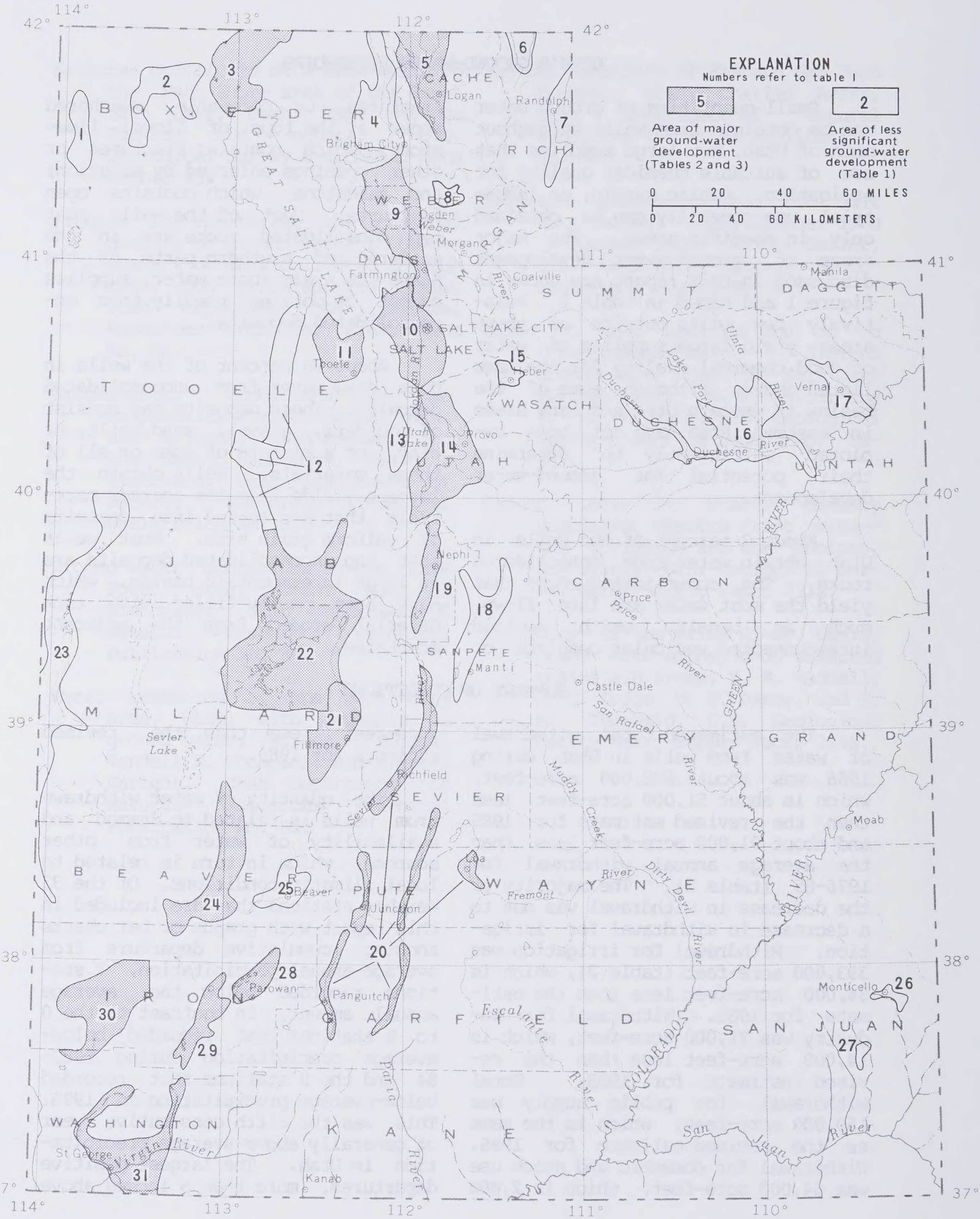


Figure 1.—Areas of ground-water development specifically referred to in this report.

Table 1.—Areas of ground-water development in Utah specifically referred to in this report

| Number in figure 1 | Area | Principal type of water-bearing rocks |
|---|---|---|
| 1 | Grouse Creek Valley | Unconsolidated |
| 2 | Park Valley | Do. |
| 3 | Curlew Valley | Unconsolidated and consolidated |
| 4 | Malad-lower Bear River valley | Unconsolidated |
| 5 | Cache Valley | Do. |
| 6 | Bear Lake valley | Do. |
| 7 | Upper Bear River valley | Do. |
| 8 | Ogden Valley | Do. |
| 9 | East Shore area | Do. |
| 10 | Salt Lake Valley | Do. |
| 11 | Tooele Valley | Do. |
| 12 | Dugway area | Do. |
| | Skull Valley | Do. |
| | Old River Bed | Do. |
| 13 | Cedar Valley, Utah County | Do. |
| 14 | Utah and Goshen Valleys | Do. |
| 15 | Heber Valley | Do. |
| 16 | Duchesne River area | Unconsolidated and consolidated |
| 17 | Vernal area | Do. |
| 18 | Sanpete Valley | Unconsolidated |
| 19 | Juab Valley | Do. |
| 20 | Central Sevier Valley | Do. |
| | Upper Sevier Valleys | Do. |
| | Upper Fremont River valley | Unconsolidated and consolidated |
| 21 | Pahvant Valley | Do. |
| 22 | Sevier Desert | Unconsolidated |
| 23 | Snake Valley | Do. |
| 24 | Milford area | Do. |
| 25 | Beaver Valley | Do. |
| 26 | Monticello area | Consolidated |
| 27 | Blanding area | Do. |
| 28 | Parowan Valley | Unconsolidated and consolidated |
| 29 | Cedar Valley, Iron County | Unconsolidated |
| 30 | Beryl-Enterprise area | Do. |
| 31 | Central Virgin River area | Unconsolidated and consolidated |

## Table 2.--Well construction and withdrawal of water from wells in Utah

Number of wells constructed in 1986.--Data provided by Utah Department of Natural Resources, Division of Water Rights. Includes deepened and replacement wells.
Diameter of 6 inches or more.--Constructed for irrigation, industry, or public supply.
Estimated withdrawals from wells.--
1985 total: From Mason and others (1986, table 2); includes some previously unpublished revisions.
1976-85 average annual: Calculated from previous reports of this series and also includes some previously unpublished revisions.

| Area | Number in figure 1 | Number of wells constructed in 1986: Total | Number of wells constructed in 1986: Diameter of 6 inches or more | Estimated withdrawals from wells (acre-feet), 1986: Irrigation | 1986: Industry | 1986: Public supply | 1986: Domestic and stock | 1986: Total (rounded) | 1985 total | 1976-85 average annual |
|---|---|---|---|---|---|---|---|---|---|---|
| Curlew Valley | 3 | 0 | 0 | 26,400 | 0 | 20 | 50 | 26,000 | 27,000 | 28,000 |
| Cache Valley | 5 | 28 | 6 | 11,000 | 8,100 | 2,400 | 1,800 | 23,000 | 22,000 | 26,000 |
| East Shore area | 9 | 92 | 4 | (1)22,800 | 9,000 | 29,800 | 4,000 | 66,000 | 67,000 | 44,000 |
| Salt Lake Valley | 10 | 88 | 20 | 2,200 | (2)10,700 | 66,200 | 25,300 | 104,000 | 110,000 | 117,000 |
| Tooele Valley | 11 | 57 | 3 | (1)16,900 | 1,450 | 2,600 | 245 | 21,000 | (3)22,000 | 27,000 |
| Utah and Goshen Valleys | 14 | 49 | 15 | 34,400 | 800 | 19,400 | 20,000 | 75,000 | 88,000 | 96,000 |
| Juab Valley | 19 | 2 | 0 | 9,100 | 0 | (4)1,000 | 300 | 10,000 | 11,000 | 17,000 |
| Sevier Desert | 22 | 16 | 0 | 7,700 | 2,000 | 810 | 300 | 11,000 | 13,000 | 25,000 |
| Upper and central Sevier Valleys and upper Fremont River valley | 20 | 27 | 3 | 11,800 | 300 | 4,600 | 5,500 | 22,000 | 21,000 | 24,000 |
| Pahvant Valley | 21 | 1 | 1 | 59,600 | 100 | 350 | 300 | 60,000 | 63,000 | 76,000 |
| Cedar Valley, Iron County | 29 | 5 | 1 | 16,000 | 700 | 2,100 | 200 | 19,000 | 23,000 | 29,000 |
| Parowan Valley | 28 | 3 | 1 | (5)23,100 | 300 | 100 | 200 | 24,000 | 25,000 | 28,000 |
| Escalante Valley | | | | | | | | | | |
| Milford area | 24 | 0 | 0 | 36,900 | (6)8,300 | 750 | 250 | 46,000 | (7)49,000 | 54,000 |
| Beryl-Enterprise area | 30 | 24 | 19 | 72,200 | (8)19,200 | 420 | 750 | 93,000 | 100,000 | 85,000 |
| Central Virgin River area | 31 | 6 | 2 | 8,100 | 1,600 | 10,000 | 250 | 20,000 | 21,000 | 20,000 |
| Other areas(9) | | 198 | 56 | 35,200 | 8,900 | 19,100 | 4,800 | 68,000 | 77,000 | 83,000 |
| Totals (rounded) | | 596 | 131 | 393,000 | 71,000 | 160,000 | 64,000 | 688,000 | (3)739,000 | 779,000 |

(1) Includes some domestic and stock use.
(2) Includes some use for air conditioning, about 30 percent of which is reinjected into the aquifer.
(3) Previously unreported revision
(4) Includes some industrial use.
(5) Includes some use for stock.
(6) Withdrawal for geothermal power generation, approximately 85 percent of which is reinjected.
(7) Includes 5,300 acre-feet withdrawn for geothermal power generation, which was not previously reported, approximately 85 percent of which was reinjected. Production of geothermal power began July, 1984.
(8) Includes 19,000 acre-feet pumped to dewater a mine and used as recharge in adjacent area.
(9) Withdrawals are estimated minimum. See page 69 for withdrawal estimates for other areas.

the average annual precipitation, were recorded at Alpine, Corinne, Logan at Utah State University, Ogden Pioneer Powerhouse, Pine View Dam, Silver Lake near Brighton, and Tooele. The negative departures, up to 3 inches below the average annual precipitation, were recorded at Beaver, Manti, Modena, Panguitch, St. George, Salina, and Snowville.

Ground-water withdrawals for 1986 were about 7 percent less than the withdrawals for 1985. Withdrawals for irrigation, industry, and domestic and stock uses decreased in 1986 while public-supply withdrawal remained the same as the revised value for 1985. Of the 16 areas referred to in this report, only Cache Valley and the upper and central Sevier Valleys and upper Fremont River valley had increased withdrawals in 1986.

Ground-water withdrawals for 1986 were about 12 percent less than the 1976-85 average annual withdrawals. Withdrawals in 13 of the 16 areas were less than or equal to the 1976-85 average (table 2). The East Shore area and the Beryl-Enterprise area of Escalante Valley both had withdrawals in 1986 that were larger than the 1976-85 average, while the Central Virgin River area withdrawals in 1986 were the same as the 10-year average.

Ground-water levels in 790 wells measured during February and March 1987 indicate that water levels statewide rose in 50 percent of the wells when compared with measurements for a similar period in 1986. The largest water-level rise in the state was 13.5 feet in a well near the University of Utah in Salt Lake Valley, while the largest decline was 12.4 feet in a well northeast of Milburn in northern Sanpete Valley.

The number of wells with water-level rises about equaled those with declines for Salt Lake and Cedar (Iron County) Valleys, all aquifers in Utah and Goshen Valleys, and the central Virgin River area. Areas with a majority of wells with water-level rises are Tooele, Curlew, Cedar (Utah County), and Pahvant Valleys, and the Sevier Desert and the East Shore area. Areas with a large number of wells showing water-level declines are Cache, Juab, Sanpete, and Parowan Valleys, the upper and central Sevier and the Fremont River Valleys, and the Milford and Beryl-Enterprise areas of Escalante Valley. Continued large withdrawals in the Beryl-Enterprise area of Escalante Valley have resulted in a continued decline of water levels in most of that area, with maximum local declines of more than 60 feet from 1935-87.

The total number of wells drilled during 1986 (table 2), as indicated by well-drillers reports filed with the Utah Division of Water Rights, was approximately 11 percent more than reported in 1985. However, the number of large-diameter wells, which are constructed mostly for public supply, irrigation, and industrial use, was nearly 30 percent less than the number reported for 1985.

The large ground-water basins and those experiencing most of the ground-water development in Utah are shown on figure 1. Information about the number of wells constructed, withdrawals of water from wells for principal uses, and total withdrawals during 1986 for the major areas of ground-water development is presented in table 2. For comparison, total withdrawals during 1985 and average annual withdrawals during 1976-85 also are shown in table 2. Annual withdrawals from the major areas of ground-water development for 1976-85 are shown in table 3.

Table 3.--Total annual withdrawal of water from wells in major areas of ground-water developement in Utah, 1976-85
[From previous reports of this series.]

| Area | Number in figure 1 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Thousands of acre-feet | | | | | | | | | |
| Curlew Valley | 3 | 27 | 31 | 27 | 29 | 30 | 40 | 26 | 18 | 20 | 27 |
| Cache Valley | 5 | 27 | 32 | 26 | 28 | 25 | 33 | 26 | 20 | 21 | 22 |
| East Shore area | 9 | 37 | 48 | 36 | 46 | 45 | 36 | 38 | 43 | 49 | 67 |
| Salt Lake Valley | 10 | 116 | 113 | 120 | 125 | 129 | 127 | 115 | 110 | 102 | 110 |
| Tooele Valley | 11 | 30 | 28 | 30 | 30 | 27 | 30 | 26 | 22 | 23 | (1)22 |
| Utah and Goshen Valleys | 14 | 107 | 118 | 104 | 107 | 94 | 101 | 86 | 74 | 78 | 88 |
| Juab Valley | 19 | 29 | 29 | 19 | 21 | 15 | 21 | 16 | 6 | 6 | 11 |
| Sevier Desert | 22 | 34 | 50 | 40 | 45 | 13 | 18 | 16 | 8 | 10 | 13 |
| Upper and central Sevier Valleys and upper Fremont River valley | 20 | 25 | 26 | 26 | 24 | 24 | 25 | 28 | 21 | 20 | 21 |
| Pahvant Valley | 21 | 95 | 117 | 88 | 86 | 75 | 80 | 69 | 42 | 42 | 63 |
| Cedar Valley, Iron County | 29 | 37 | 40 | 31 | 32 | 28 | 29 | 28 | 21 | 20 | 23 |
| Parowan Valley | 28 | 34 | 33 | 29 | 30 | 28 | 27 | 25 | 22 | 22 | 25 |
| Escalante Valley | | | | | | | | | | | |
| Milford area | 24 | 65 | 65 | 58 | 49 | 61 | 69 | 55 | 39 | 32 | (1)49 |
| Beryl-Enterprise area | 30 | 79 | 81 | 71 | 79 | 71 | 93 | 99 | 86 | 95 | 100 |
| Central Virgin River area(2) | 31 | 17 | 18 | 20 | 20 | 20 | 22 | 27 | 16 | 19 | 21 |
| Other areas | | 89 | 108 | 92 | 92 | 70 | 83 | 100 | 52 | 64 | 77 |
| Totals | | 848 | 937 | 817 | 843 | 755 | 834 | 780 | 600 | 623 | (1)739 |

(1) Previously unpublished revision
(2) Prior to 1984 included under 'Other Areas'

## MAJOR AREAS OF GROUND-WATER DEVELOPMENT

### CURLEW VALLEY

by G. J. Smith

Withdrawal of water from irrigation wells in 1986 in Curlew Valley was approximately 26,000 acre-feet, 1,000 acre-feet less than the amount reported in 1985 and 2,000 acre-feet less than the ten-year average during 1976-85 of 28,000 acre-feet per year (table 2).

From March 1986 to March 1987 water levels in Curlew Valley generally rose slightly, except in two wells north of Kelton where water levels declined (fig. 2) due to nearby pumping.

The relation of water levels in two selected observation wells to cumulative departure from average annual precipitation at Snowville and to annual withdrawals from wells is shown in figure 3. The hydrograph for well (B-14-9)7bbb-1 is representative of irrigated areas near Snowville, and shows a general decline in water levels from 1962 to 1982. From 1982 to 1986, water levels generally rose in this well, including a 0.2 foot rise from March 1986 to March 1987. Well (B-12-11)16cdc-1 is on the outskirts of the irrigated area near Kelton, Utah. The hydrograph of this well shows a declining trend during 1954-82, followed by a rise since 1982 similar to the hydrograph of the well near Snowville. However, a small decline was measured from March 1986 to March 1987. Precipitation at Snowville in 1986 was 12.32 inches, 0.22 inches below the average annual precipitation for 1941 through 1986.


Figure 2.—Map of Curlew Valley showing change of water levels from March 1986 to March 1987.

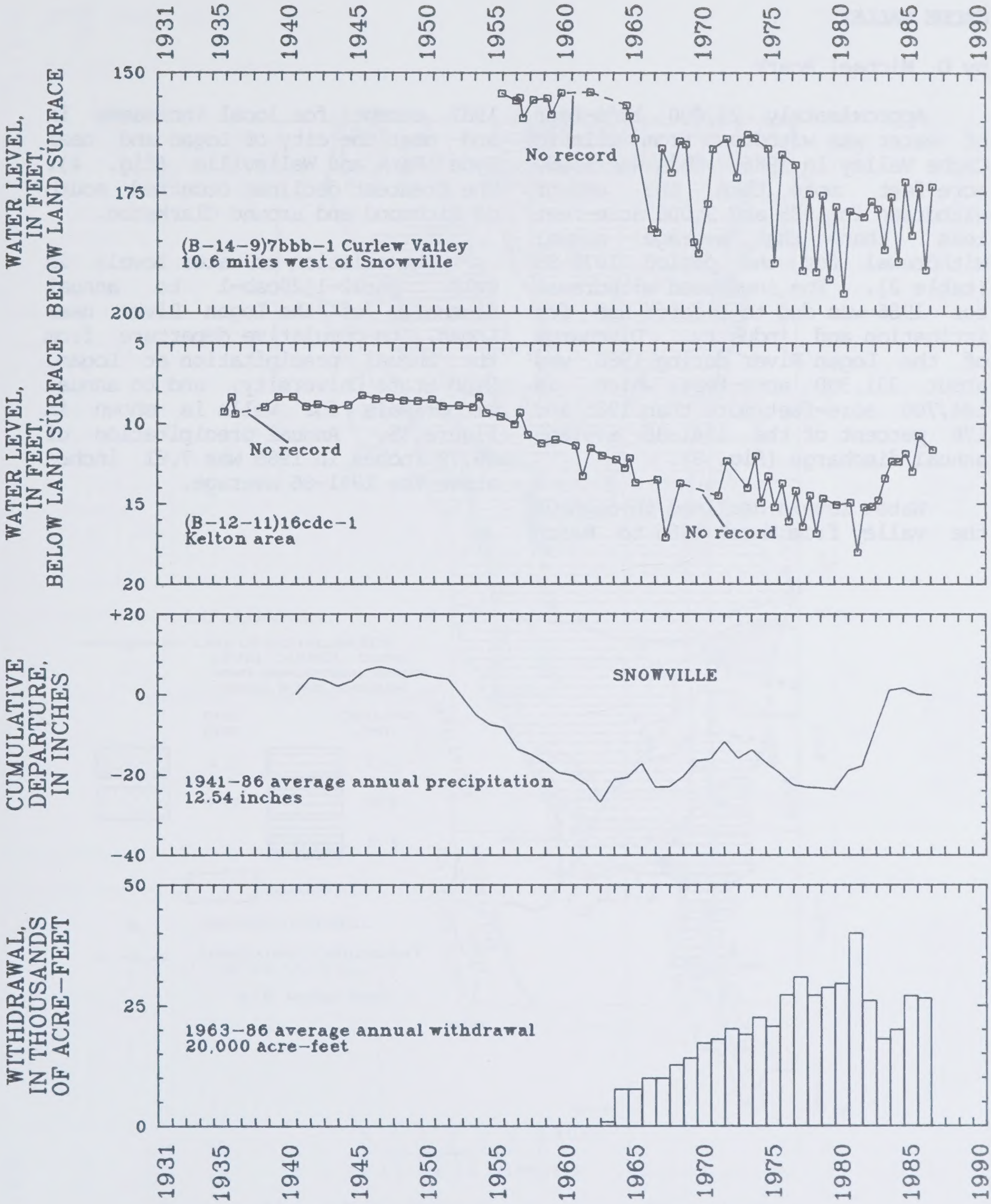


Figure 3.—Relation of water levels in selected wells in Curlew Valley to cumulative departure from the average annual precipitation at Snowville and to annual withdrawals from wells.

## CACHE VALLEY

by D. Michael Roark

Approximately 23,000 acre-feet of water was withdrawn from wells in Cache Valley in 1986. This was 1,000 acre-feet more than the amount withdrawn in 1985 and 3,000 acre-feet less than the average annual withdrawal for the period 1976-85 (table 2). The increased withdrawal for 1986 was due to greater use for irrigation and industry. Discharge of the Logan River during 1986 was about 331,300 acre-feet, which is 144,700 acre-feet more than 1985 and 176 percent of the 1941-86 average annual discharge (fig. 5).

Water levels declined throughout the valley from March 1986 to March 1987 except for local increases in and near the city of Logan and near Hyde Park and Wellsville (fig. 4). The greatest declines occurred south of Richmond and around Clarkston.

The relation of water levels in well (A-12-1)29cab-1 to annual discharge of the Logan River near Logan, to cumulative departure from the annual precipitation at Logan, Utah State University, and to annual withdrawals for wells is shown in figure 5. Annual precipitation of 26.78 inches in 1986 was 7.81 inches above the 1941-86 average.

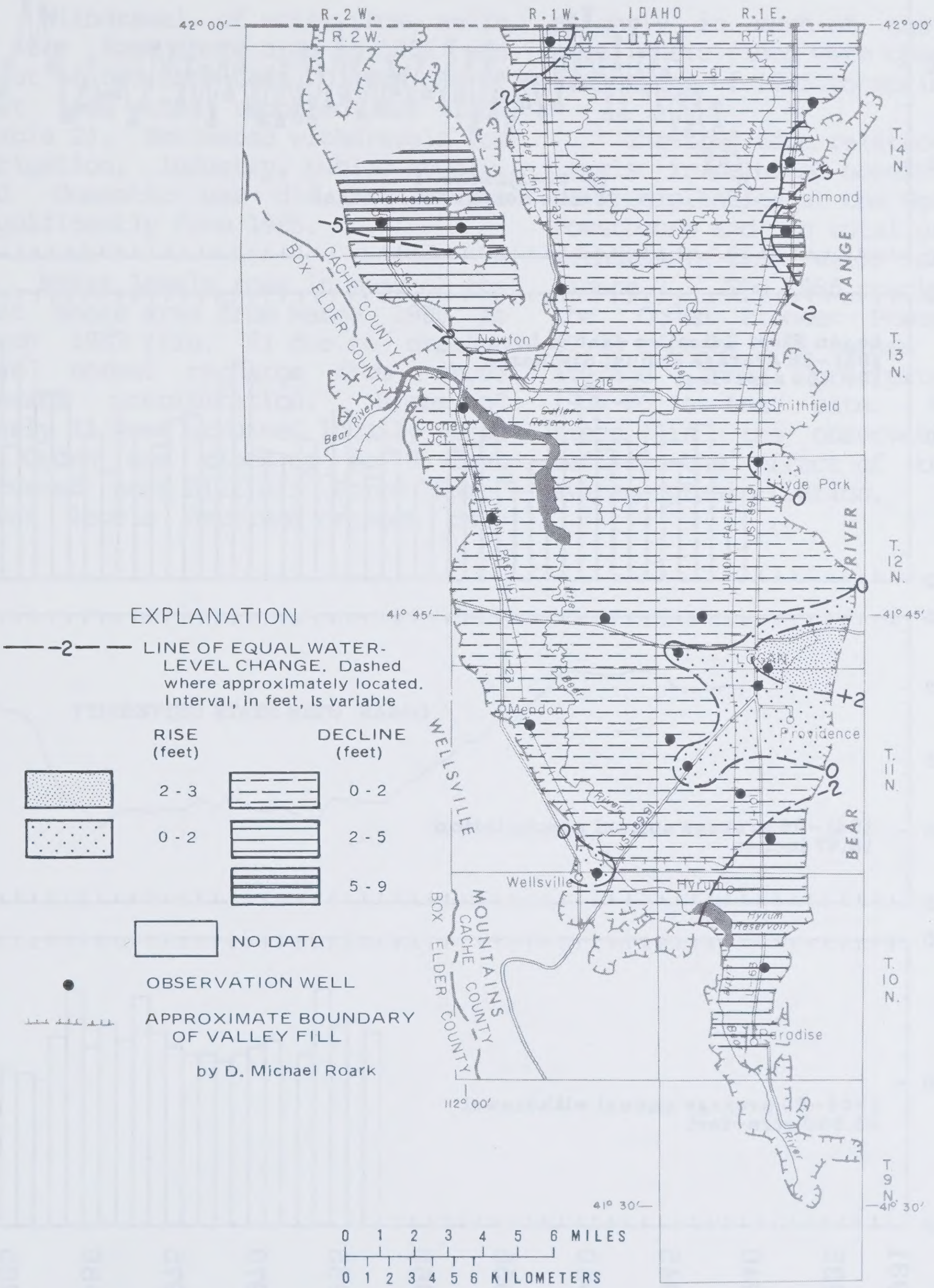

Figure 4.—Map of Cache Valley showing change of water levels from March 1986 to March 1987.

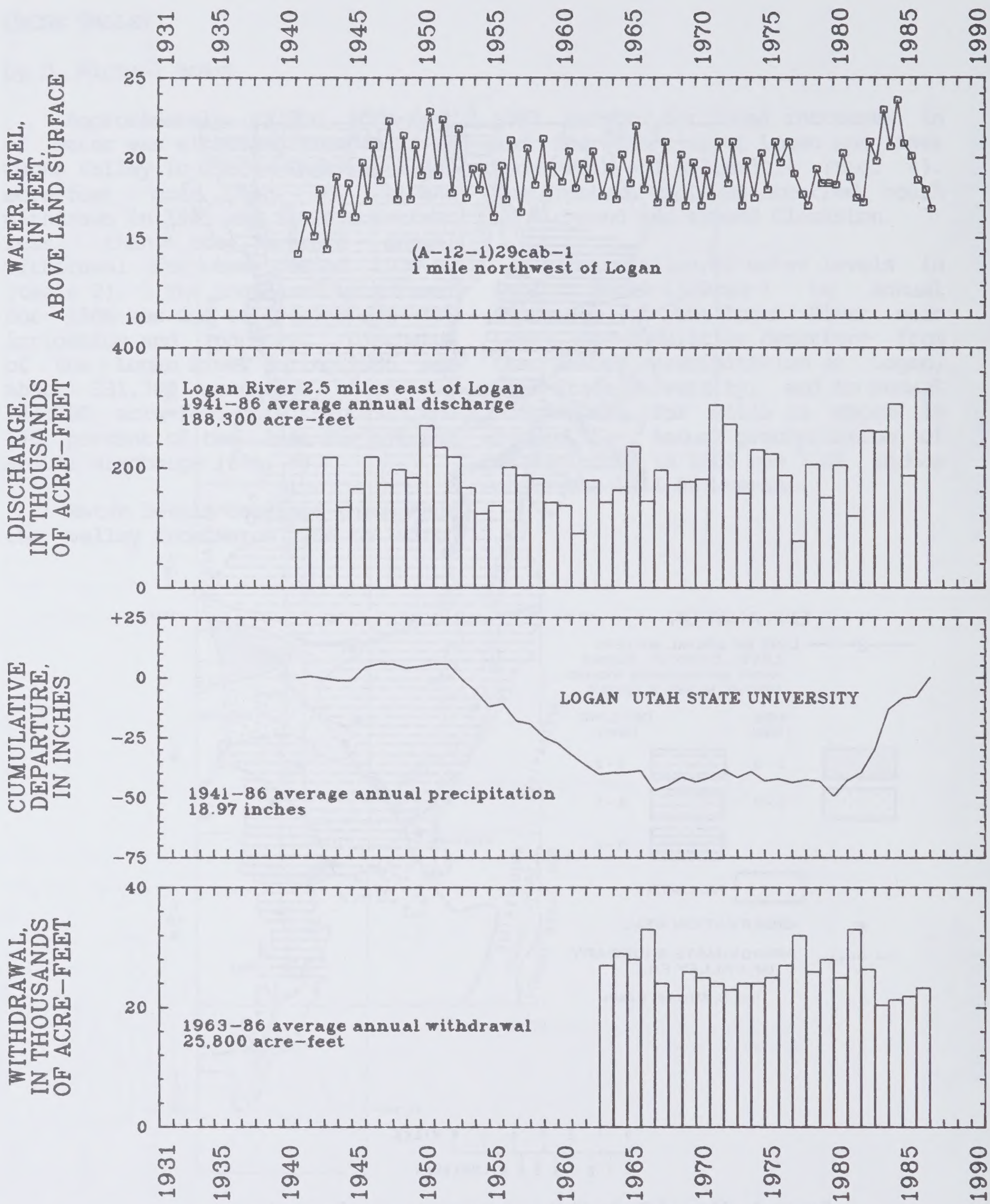


Figure 5.—Relation of water levels in well (A-12-1)29cab-1 in Cache Valley to discharge of the Logan River near Logan, to cumulative departure from the average annual precipitation at Logan, Utah State University, and to annual withdrawals from wells.

## EAST SHORE AREA

by Patrick M. Lambert

Withdrawal of water from wells in the East Shore area in 1986 was about 66,000 acre-feet, 1,000 acre-feet less than reported for 1985 (table 2). Estimated withdrawals for irrigation, industry, public supply, and domestic use did not change significantly from 1985.

Water levels rose in most of the East Shore area from March 1986 to March 1987 (fig. 6) due to greater than normal recharge from above average precipitation. Rises of nearly 11 feet occurred locally north of Ogden and rises up to 8 feet occurred near Hill Air Force Base. Water levels declined or rose only slightly in much of the discharge area where rises were observed from the spring of 1985 to spring of 1986.

The long-term relation of water levels in selected observation wells to precipitation at the Ogden Pioneer Powerhouse and to total ground-water withdrawals from wells is shown in figure 7. The 1986 precipitation at the Ogden Pioneer Powerhouse was 27.53 inches, 5.71 inches above the average annual precipitation for 1937-86 at that site. Water-level rises in the observation wells reflect the effect of this above-average precipitiation.

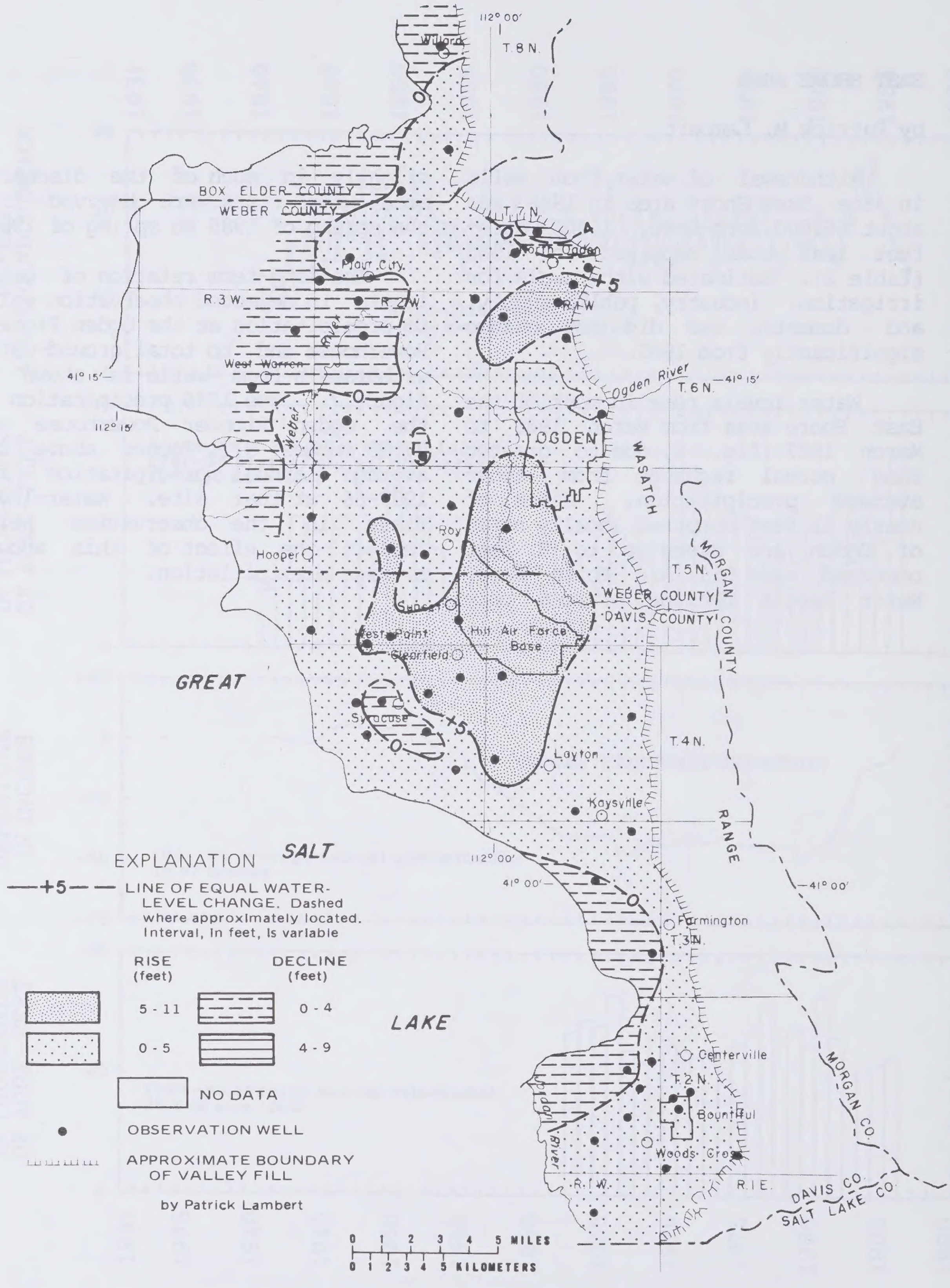


Figure 6.—Map of the East Shore area showing change of water levels from March 1986 to March 1987.

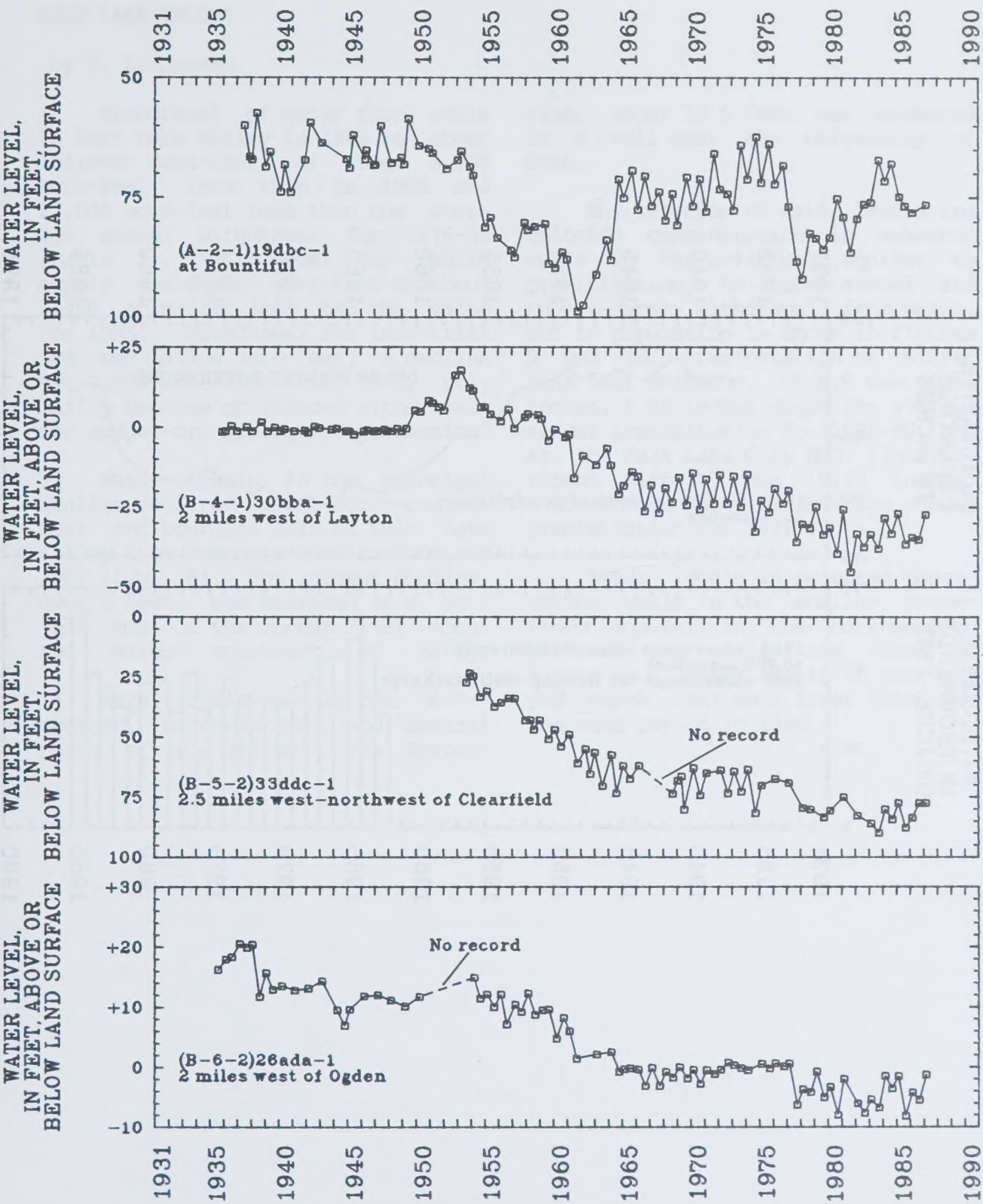


Figure 7.—Relation of water levels in selected wells in the East Shore area to cumulative departure from the average annual precipitation at Ogden Pioneer Powerhouse and to annual withdrawals from wells.

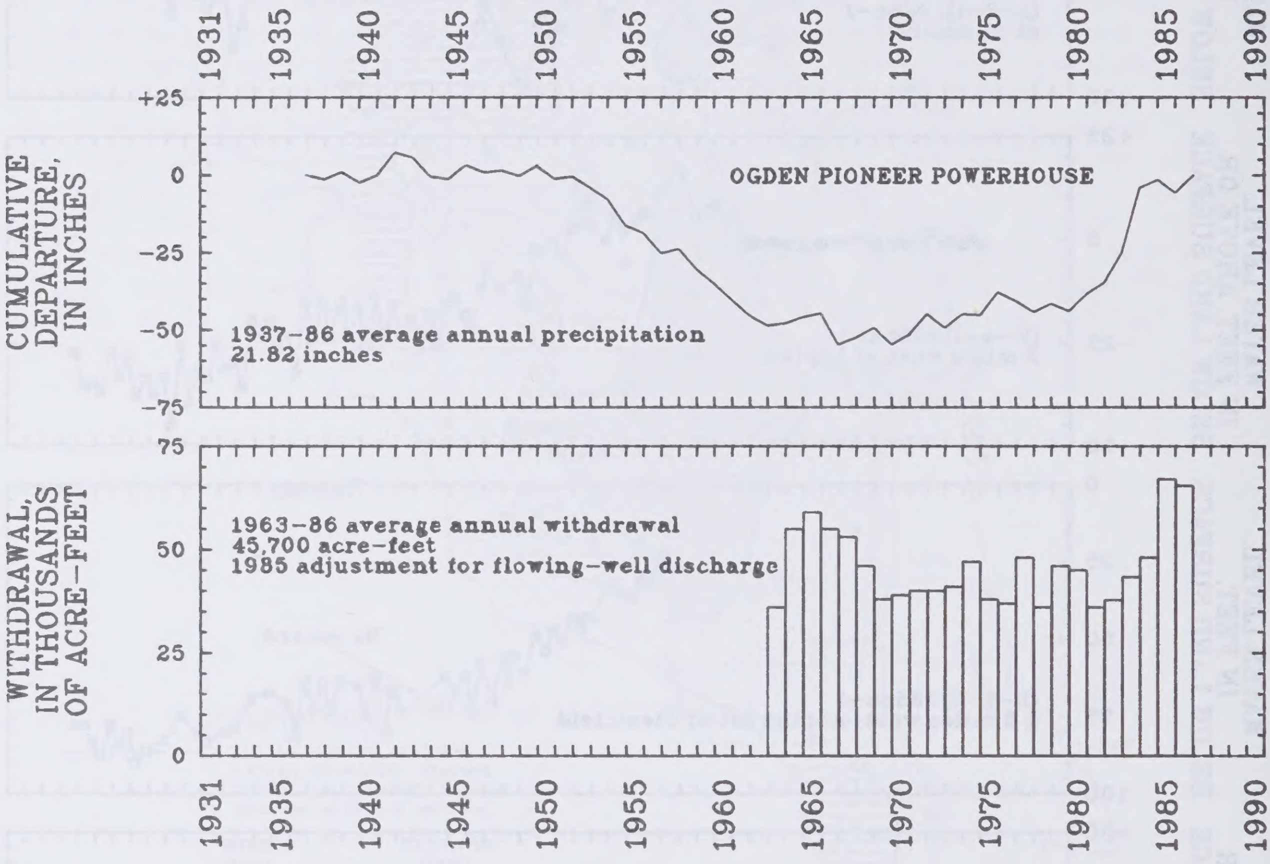


Figure 7.—Continued

## SALT LAKE VALLEY

by V. L. Jensen

Withdrawal of water from wells in Salt Lake Valley in 1986 was about 104,000 acre-feet, or about 6,000 acre-feet less than in 1985 and 13,000 acre-feet less than the average annual withdrawal for 1976-85 (table 2). Withdrawal for public supply was 66,200 acre-feet or about 2,900 acre-feet less than the value for 1985. Withdrawal for industrial use was 10,700 acre-feet, a decline of 1,400 acre-feet from 1985, primarily because of reduced withdrawals for copper-ore mining and processing.

Water levels in the principal aquifer declined in the north-central part and southern half of Salt Lake Valley from February 1986 to February 1987 (fig. 8). The largest decline, over 5 feet, was measured in a well just east of the Jordan River about two miles southwest of Sandy.

Water levels rose in the northwestern, northeastern, and central parts of the valley. The largest rise, about 13.5 feet, was measured in a well near the University of Utah.

The relation of water levels and chloride concentration in selected wells in the principal aquifer to precipitation, to total annual and public-supply withdrawals from wells, and to population is shown in figures 9 and 10. Precipitation at Silver Lake near Brighton, Utah, was 50.13 inches, 6.98 inches above the average annual precipitation for 1931-86, and at the Salt Lake City WSO (International Airport) was 19.40 inches, 4.05 inches above the average annual precipitation for 1931-86.

Water levels in selected observation wells in the shallow unconfined aquifer in the northwestern part of the valley are shown in figure 11. Water levels in February and March 1987 were lower than for the same period in 1986.

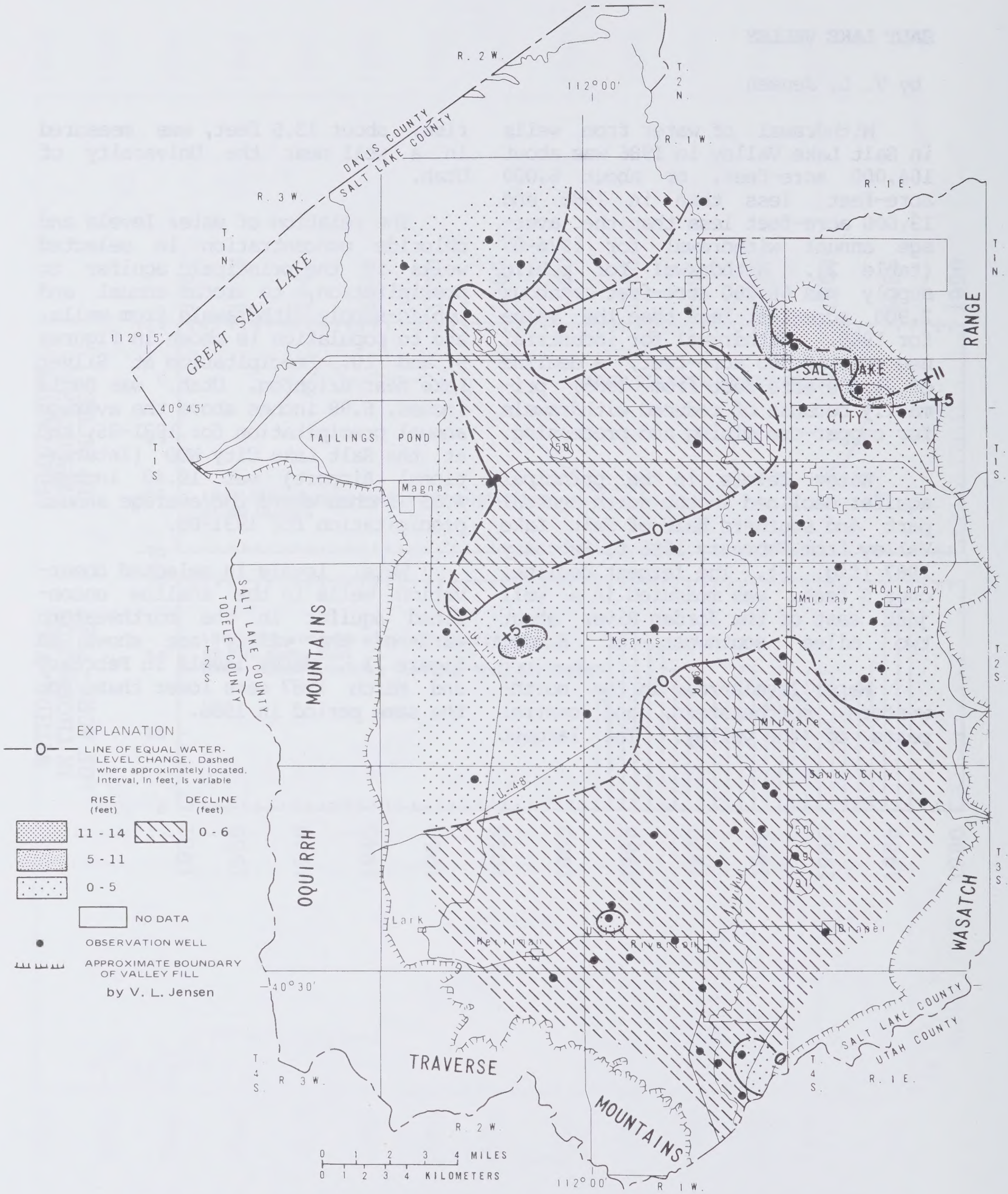


Figure 8.—Map of the Salt Lake Valley showing change of water levels in the principal aquifer from February 1986 to February 1987.

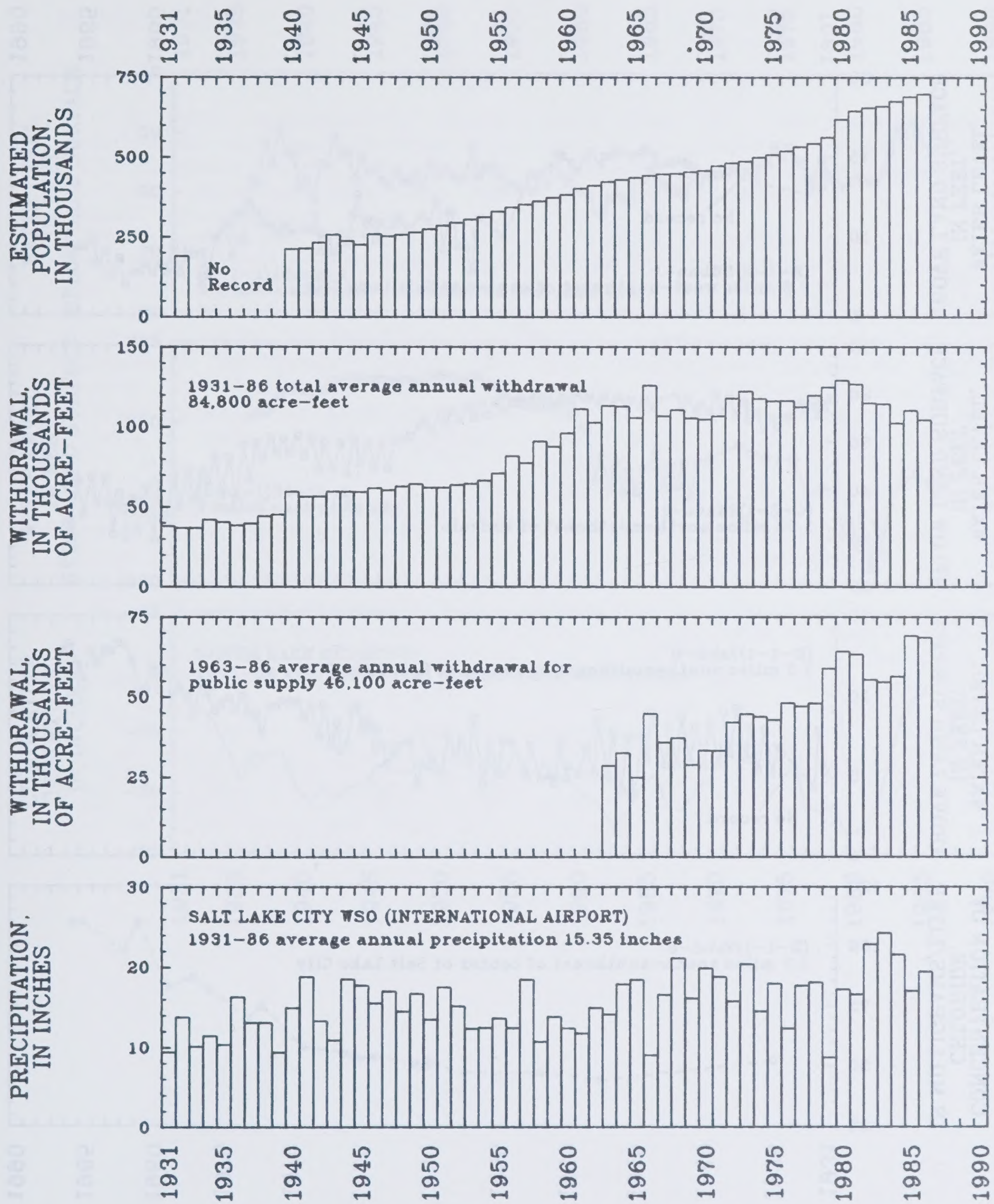


Figure 9.—Estimated population of Salt Lake County, total annual withdrawals from wells, annual withdrawal for public supply, and average annual precipitation at Salt Lake City WSO (International Airport).

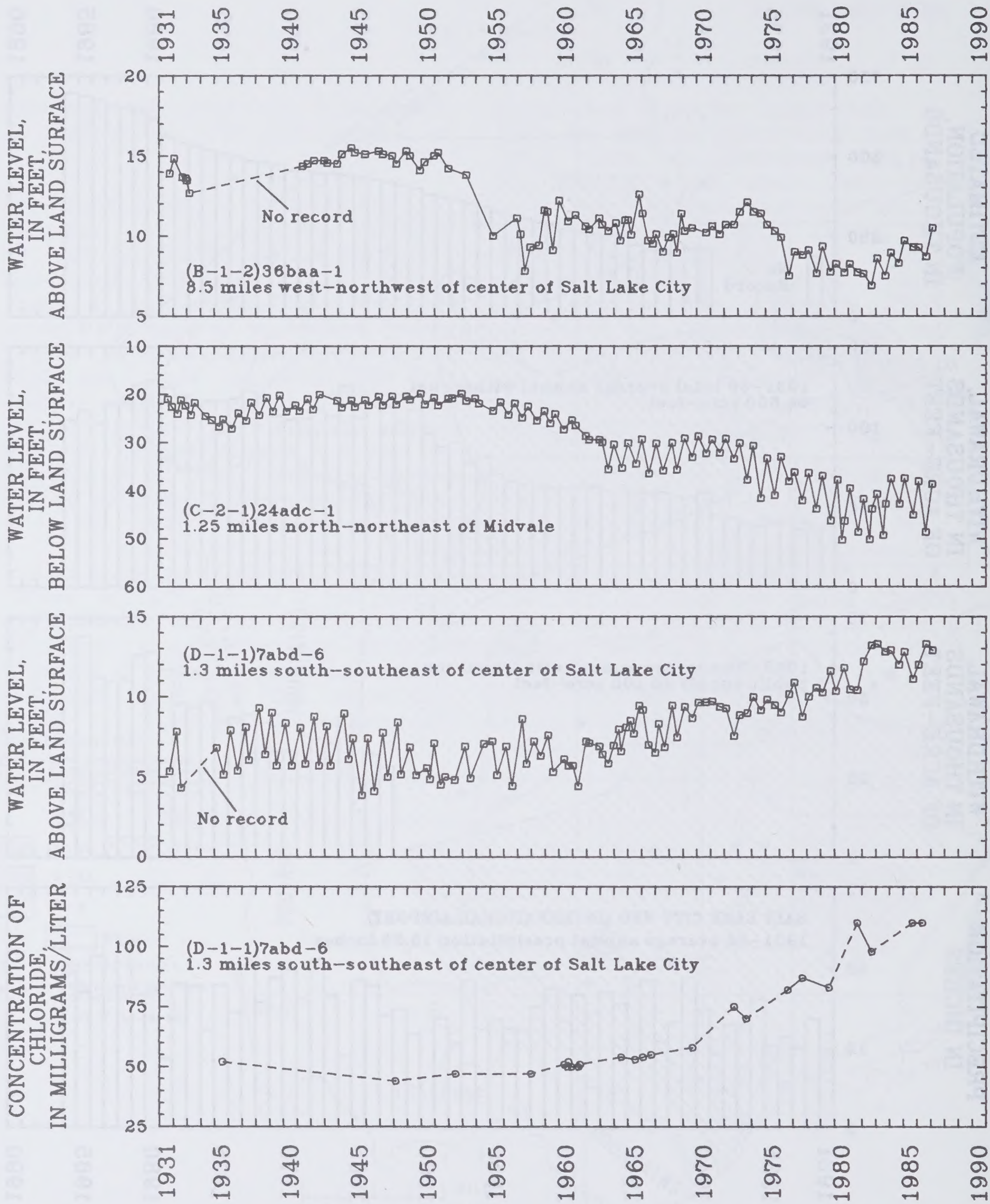


Figure 10.—Relation of water levels and chloride concentration in selected wells in the principal aquifer in Salt Lake Valley to cumulative departure from the average annual precipitation at Silver Lake Brighton.

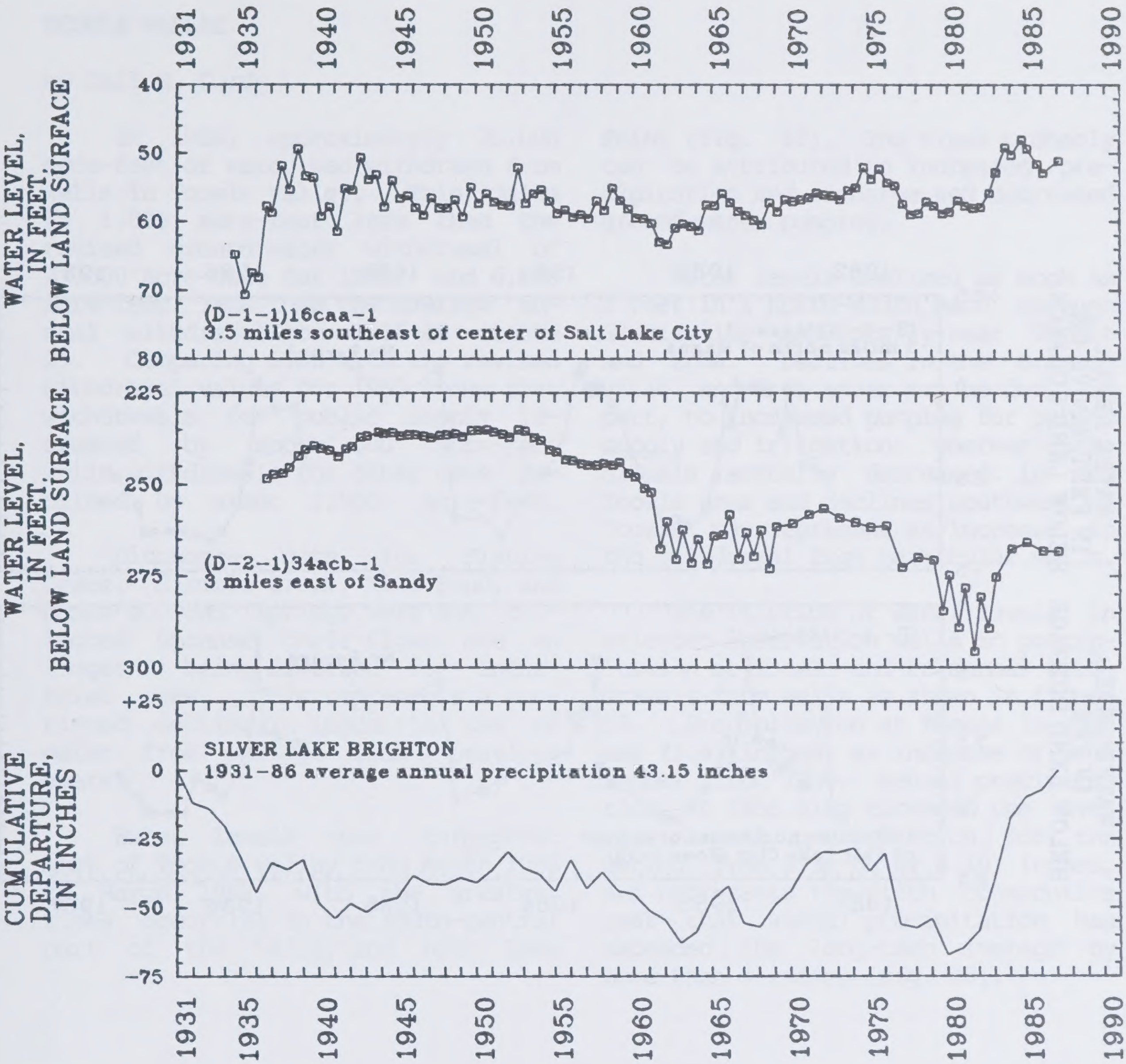


Figure 10.—Continued

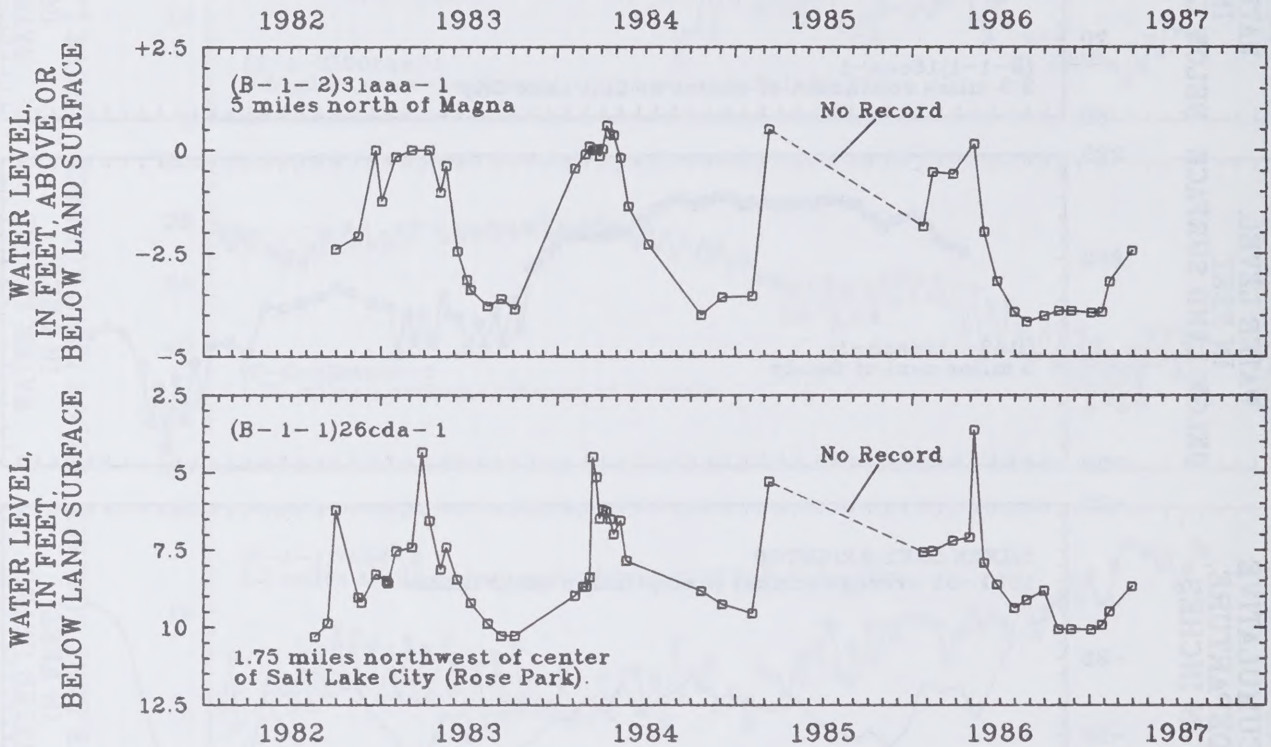


Figure 11.—Water levels in selected wells in the shallow unconfined aquifer in Salt Lake Valley.

## TOOELE VALLEY

by Gail E. Cordy

In 1986, approximately 21,000 acre-feet of water was withdrawn from wells in Tooele Valley. This value is 1,000 acre-feet less than the revised ground-water withdrawal of 22,000 acre-feet for 1985, and 6,000 acre-feet less than the average annual withdrawal for 1976-85 (table 2). Comparing 1986 with the revised withdrawal values for 1985 shows that withdrawals for public supply increased by about 300 acre-feet while withdrawals for other uses declined by about 1,500 acre-feet.

Discharge data for Fishing Creek, Sixmile Creek, Mill Pond, and Dunne's Pond Springs were not collected because their flows are no longer being diverted for industrial uses. This represents a continued decline in industrial use of water from springs from previous years.

Water levels rose throughout most of Tooele Valley from March 1986 to March 1987, with the greatest rises occurring in the south-central part of the valley and near Lake Point (fig. 12). The rises probably can be attributed to increased precipitation and recharge and decreased ground-water pumping.

Water levels declined as much as 4 feet in a north-south band through Grantsville and locally near Tooele and Erda. Declines in the Grantsville and Erda areas may be due, in part, to increased pumping for public supply and irrigation; whereas withdrawals actually decreased in the Tooele area and declines southwest of Tooele may represent an increase in the withdrawal from particular wells.

The relation of water levels in selected observation wells to precipitation at Tooele and to annual withdrawals from wells is shown in figure 13. Precipitation at Tooele in 1986 was 25.47 inches; an increase of 3.70 inches from 1985. Annual precipitation in 1986 also exceeded the average annual precipitation for the period from 1936-86 by 8.10 inches, and represents the fifth consecutive year that annual precipitation has exceeded the long-term average by more than 4 inches (fig. 13).


Figure 12.—Map of Tooele Valley showing change of water levels in artesian aquifers from March 1986 to March 1987.

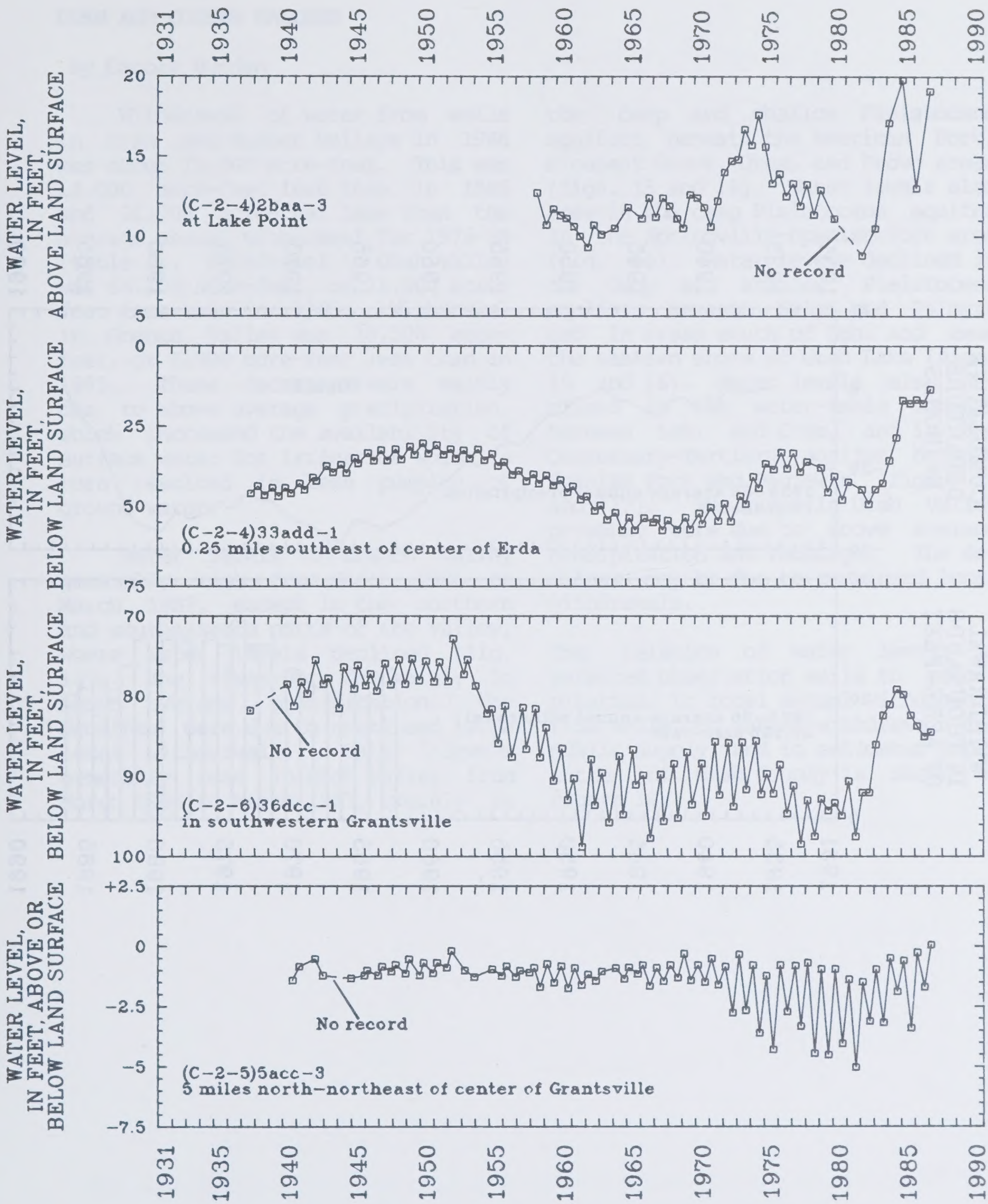


Figure 13.—Relation of water levels in selected wells in Tooele Valley to cumulative departure from the average annual precipitation at Tooele and to annual withdrawals from wells.

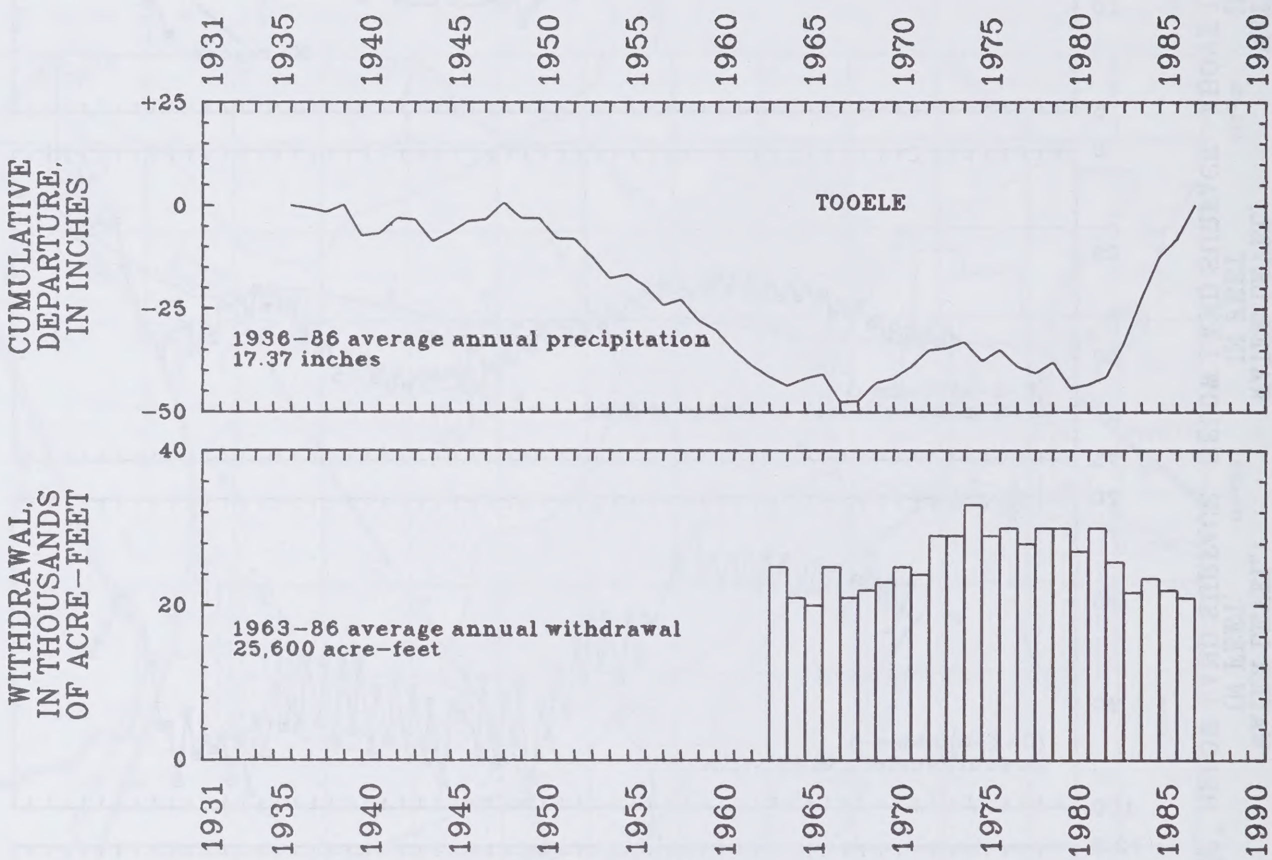


Figure 13.—Continued

## UTAH AND GOSHEN VALLEYS

by Carole Burden

Withdrawal of water from wells in Utah and Goshen Valleys in 1986 was about 75,000 acre-feet. This was 13,000 acre-feet less than in 1985 and 21,000 acre-feet less than the average annual withdrawal for 1976-85 (table 2). Withdrawal in Utah Valley was 64,400 acre-feet, or 11,600 acre-feet less than in 1985. Withdrawal in Goshen Valley was 10,300 acre-feet, or 1,700 acre-feet less than in 1985. These decreases were mainly due to above average precipitation, which increased the availability of surface water for irrigation which in turn resulted in less pumping of ground water.

Water levels in Goshen Valley generally rose from March 1986 to March 1987, except in the northern and southeastern parts of the valley, where water levels declined (fig. 14). The rises were due mainly to above average precipitation. The declines were due to continued large local withdrawals. Water levels generally rose in Utah Valley from March 1986 to March 1987, mainly in the deep and shallow Pleistocene aquifers beneath the American Fork, Pleasant Grove, Orem, and Provo areas (figs. 15 and 16). Water levels also rose in the deep Pleistocene aquifer in the Springville-Spanish Fork area (fig. 16). Water levels declined in the deep and shallow Pleistocene aquifers beneath Salem and Palmyra and in areas south of Lehi and near the eastern shore of Utah Lake (figs. 15 and 16). Water levels also declined in the water-table aquifer between Lehi and Orem, and in the Quaternary-Tertiary aquifer between Spanish Fork and Benjamin (figs. 14 and 17). The rises in Utah Valley probably were due to above average precipitation and recharge. The declines may be due to continued local withdrawals.

The relation of water levels in selected observation wells to precipitation, to total annual withdrawals from wells, to annual withdrawals for public supply, and to estimated population of Utah County is shown in figure 18.

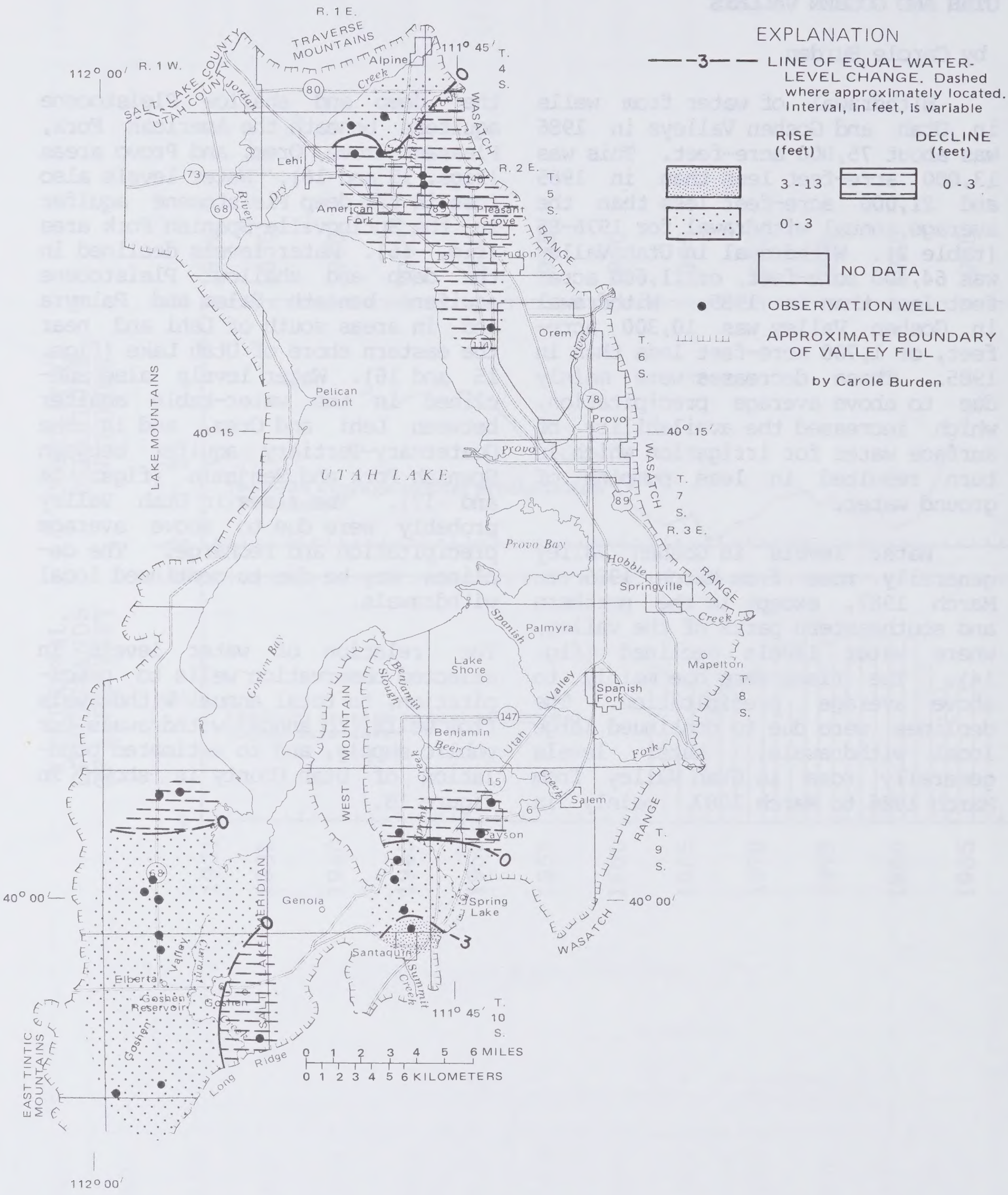


Figure 14.—Map of Utah and Goshen Valleys showing change of water levels in the water-table aquifers from March 1986 to March 1987.

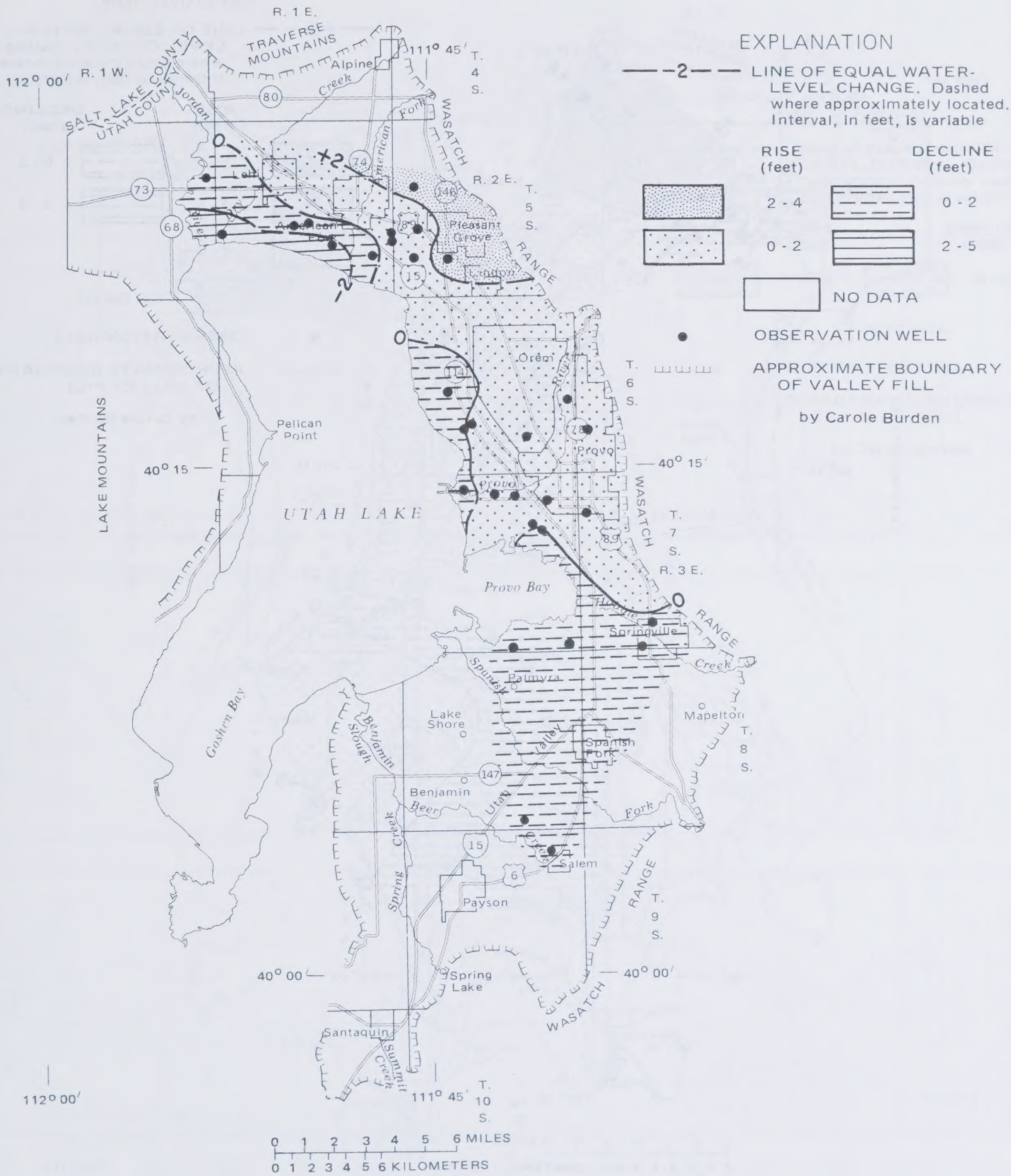


Figure 15.—Map of Utah Valley showing change of water levels in the shallow artesian aquifer in deposits of Pleistocene age from March 1986 to March 1987.

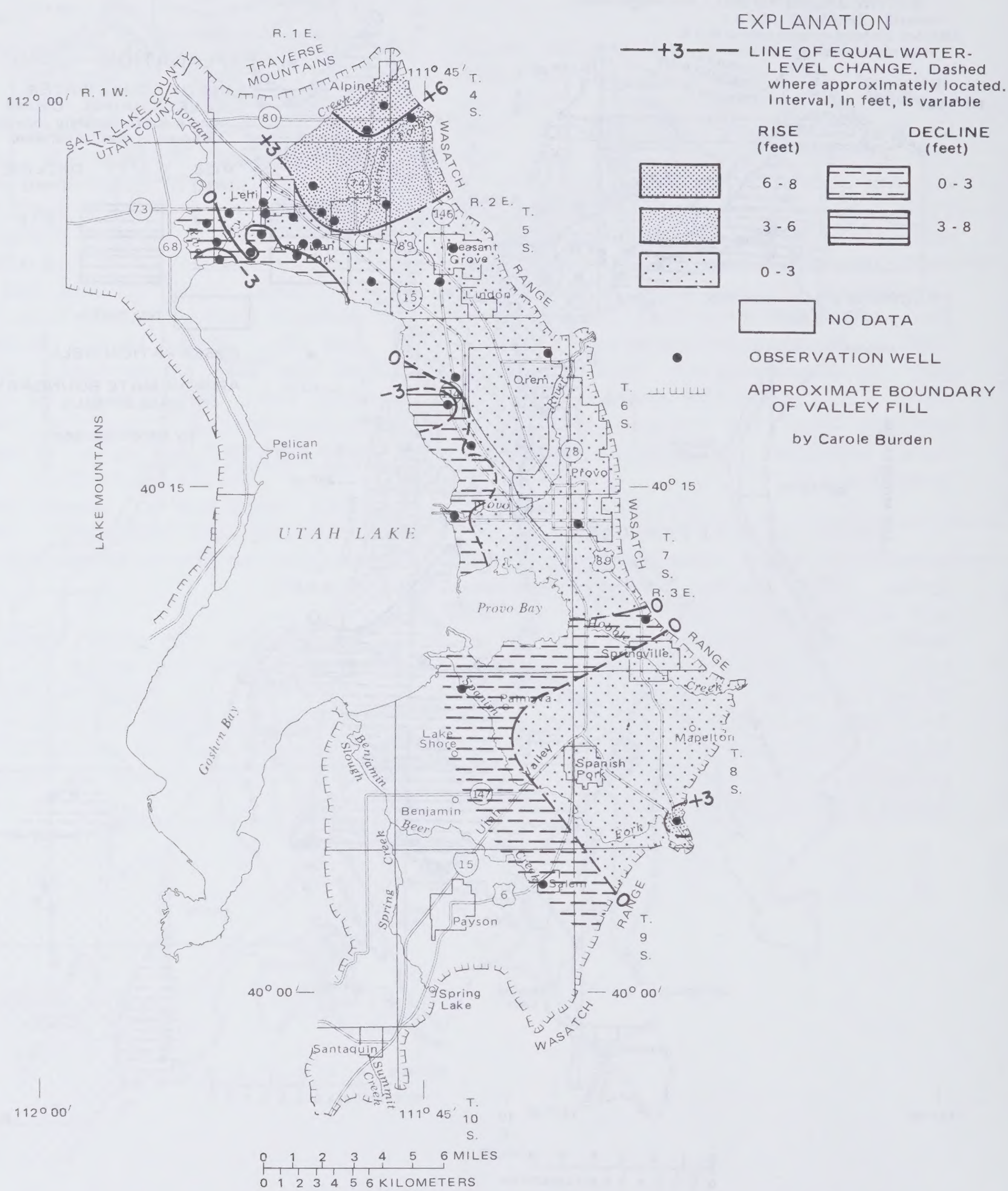


Figure 16.—Map of Utah Valley showing change of water levels in the deep artesian aquifer in deposits of Pleistocene age from March 1986 to March 1987.

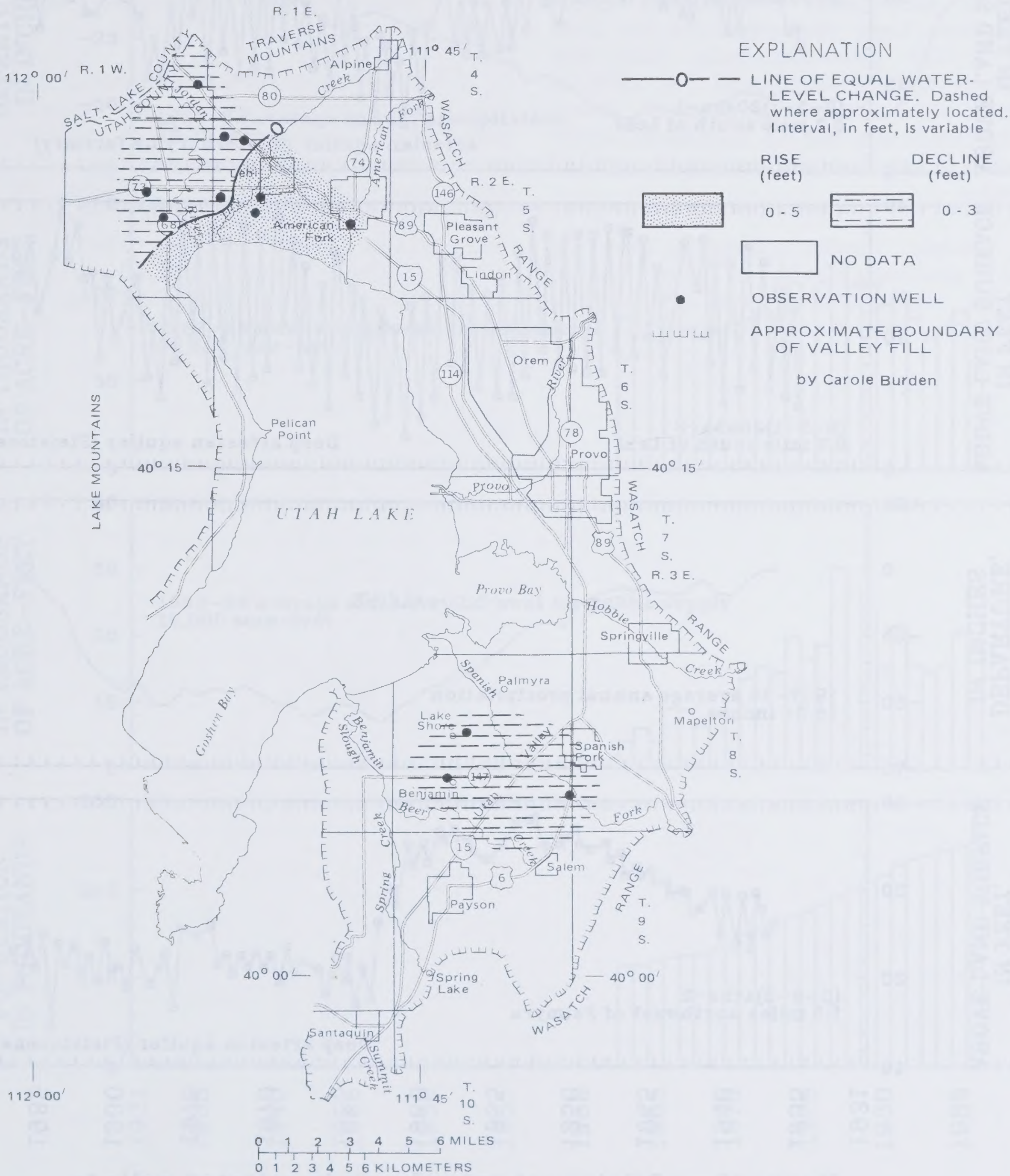


Figure 17.—Map of Utah Valley showing change of water levels in the artesian aquifer in deposits of Quaternary or Tertiary age from March 1986 to March 1987.

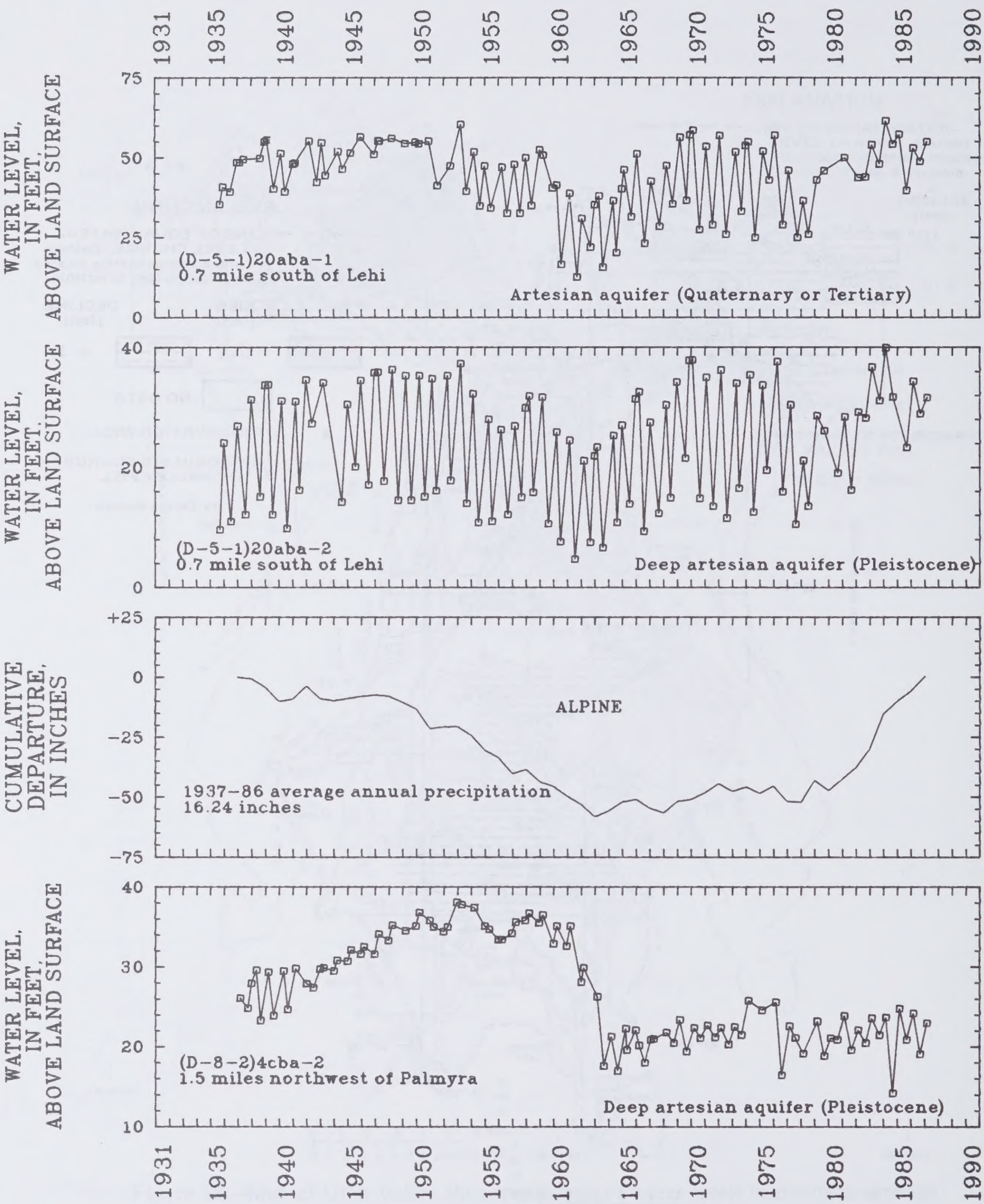


Figure 18.—Relation of water levels in selected wells to cumulative departure from the average annual precipitation at Alpine and Spanish Fork Powerhouse, to total annual withdrawals from wells and annual withdrawals for public supply in Utah and Goshen Valleys, and to estimated population of Utah County.

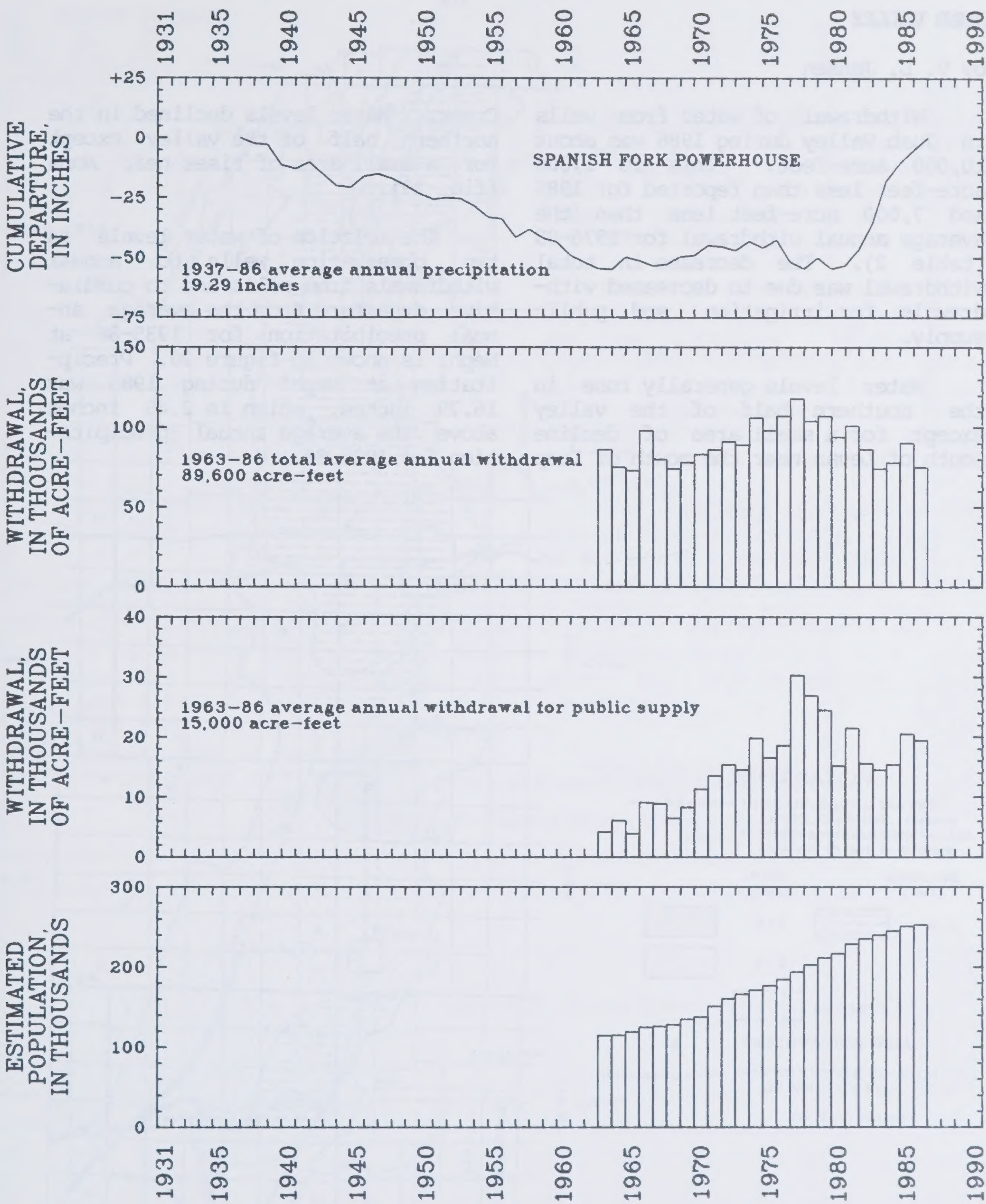


Figure 18.—Continued

## JUAB VALLEY

by V. L. Jensen

Withdrawal of water from wells in Juab Valley during 1986 was about 10,000 acre-feet. This is 1,000 acre-feet less than reported for 1985 and 7,000 acre-feet less than the average annual withdrawal for 1976-85 (table 2). The decrease in total withdrawal was due to decreased withdrawals for irrigation and public supply.

Water levels generally rose in the southern half of the valley except for a small area of decline south of Levan near the mouth of Deep Creek. Water levels declined in the northern half of the valley except for a small area of rises near Mona (fig. 19).

The relation of water levels in two observation wells to annual withdrawals from wells and to cumulative departure from the average annual precipitation for 1935-86 at Nephi is shown in figure 20. Precipitation at Nephi during 1986 was 16.79 inches, which is 2.45 inches above the average annual precipitation for 1935-86.

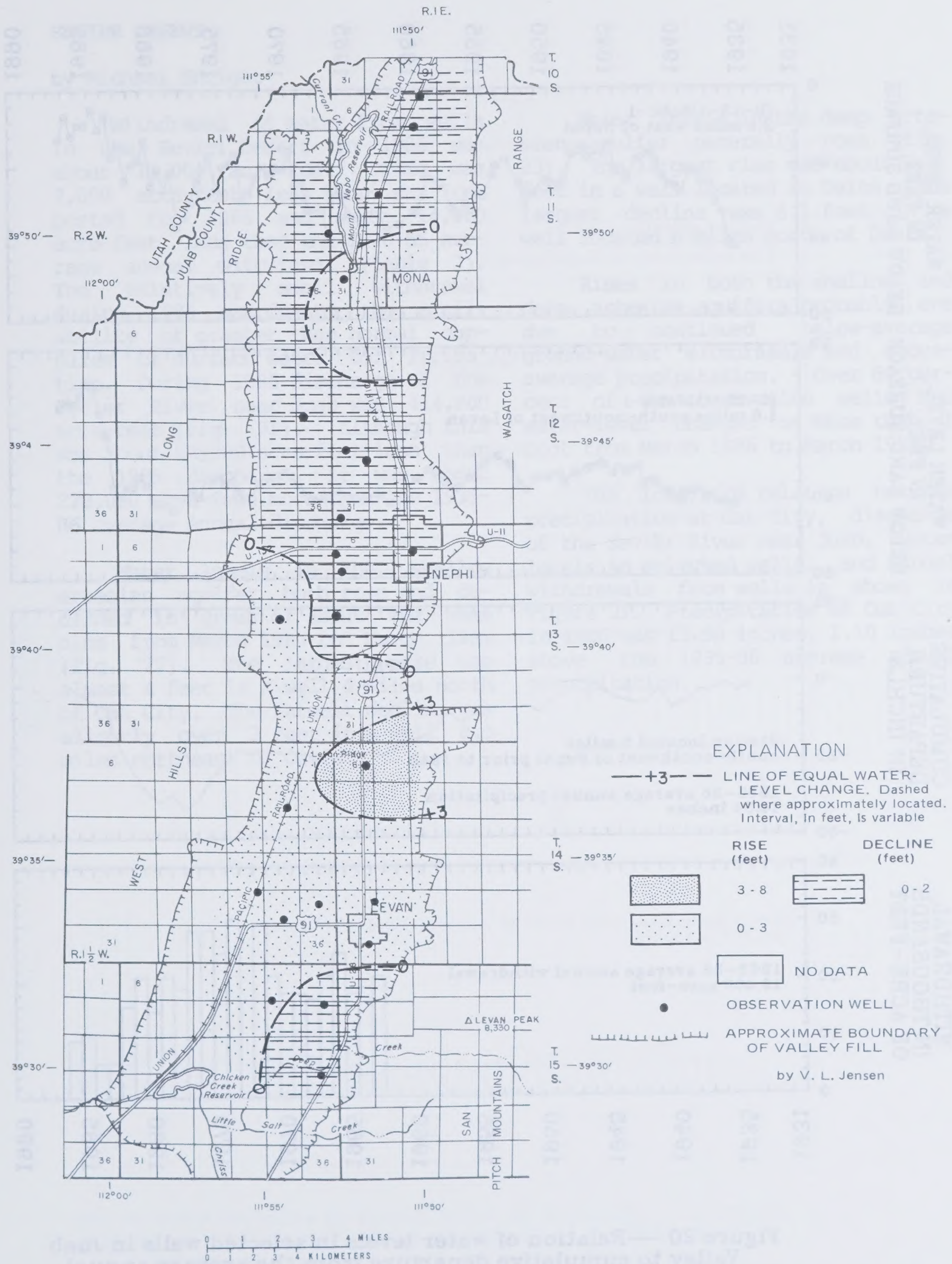


Figure 19.– Map of Juab Valley showing change of water levels from March 1986 to March 1987.

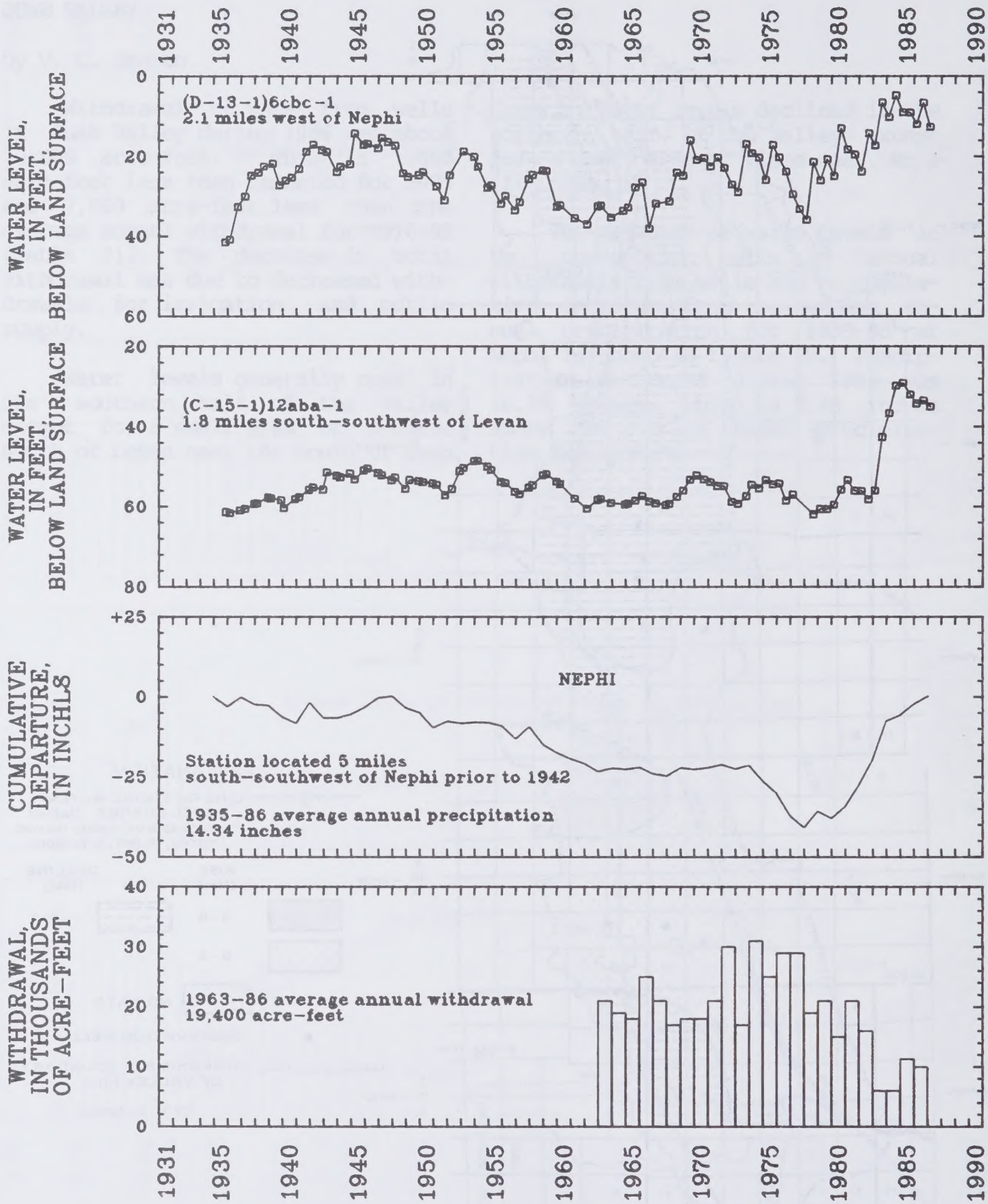


Figure 20.—Relation of water levels in selected wells in Juab Valley to cumulative departure from the average annual precipitation at Nephi and to annual withdrawals from wells.

## SEVIER DESERT

by Michael Enright

Withdrawal of water from wells in the Sevier Desert in 1986 was about 11,000 acre-feet. This was 2,000 acre-feet less than was reported for 1985 and about 14,000 acre-feet less than the 1976-85 average annual withdrawal (table 2). The relatively small withdrawal during 1986 was due to the availability of greater than normal supplies of surface water for irrigation. During 1986 discharge of the Sevier River near Juab was 414,900 acre-feet (fig. 21). Although this was about 88,900 acre-feet less than the 1985 discharge, it was about 228,000 acre-feet more than the 1935-86 average annual discharge.

Water levels in the shallow artesian aquifer both rose and declined in areas of about the same size from March 1986 to March 1987 (fig. 22). The largest rise was almost 4 feet in a well 4 miles north of Oak City. The largest decline was slightly over 3 feet in a well 0.5 miles northeast of Oasis.

Water levels in the deep artesian aquifer generally rose (fig. 23). The largest rise was about 3.5 feet in a well located in Delta. The largest decline was 6.1 feet in a well located 8 miles north of Delta.

Rises in both the shallow and deep artesian aquifers probably are due to continued below-average ground-water withdrawals and above-average precipitation. Over 80 percent of the observation wells had water-level changes of less than 1 foot from March 1986 to March 1987.

The long-term relation between precipitation at Oak City, discharge of the Sevier River near Juab, water levels in selected wells, and annual withdrawals from wells is shown in figure 21. Precipitation at Oak City in 1986 was 13.98 inches, 1.10 inches above the 1935-86 average annual precipitation.

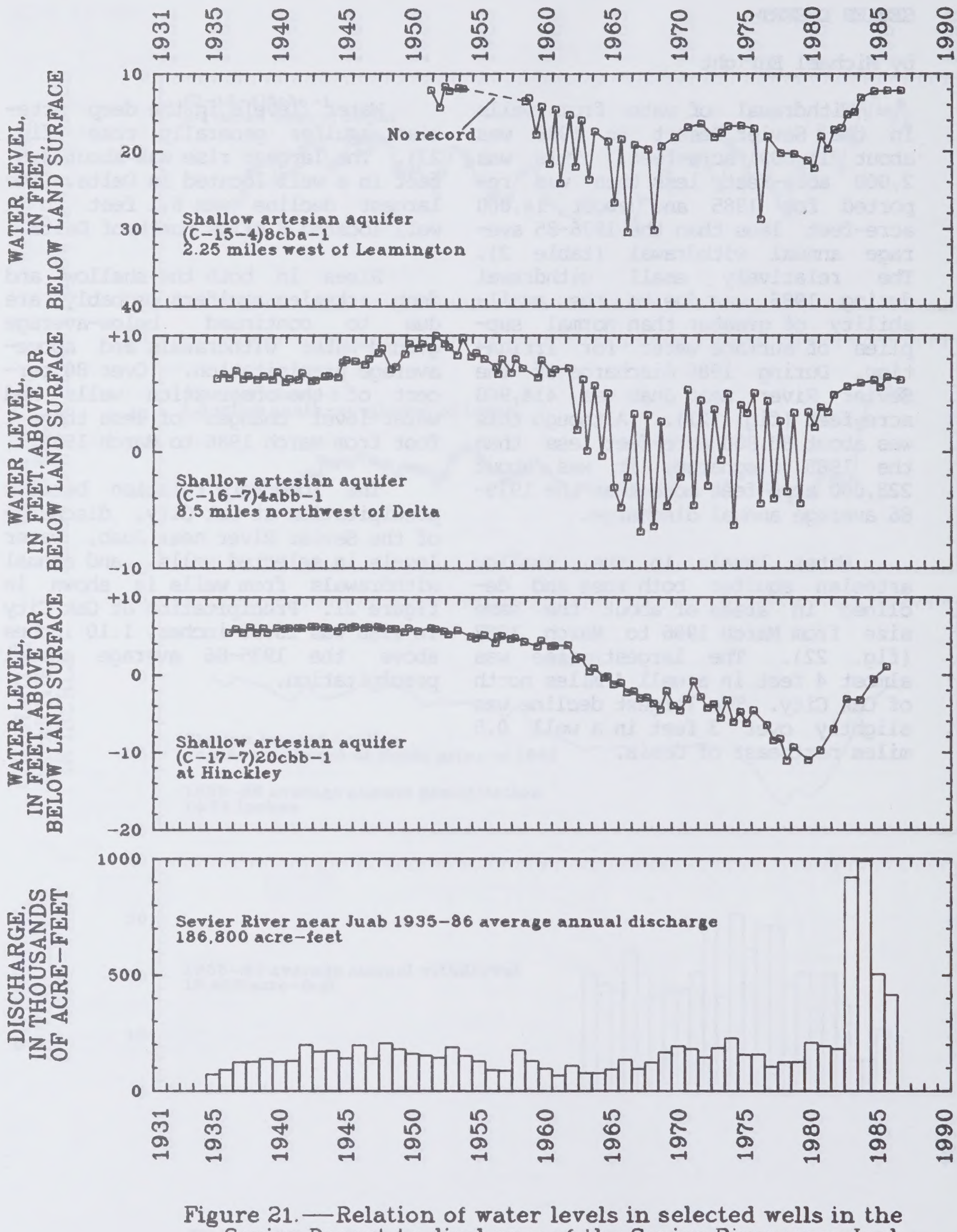


Figure 21.—Relation of water levels in selected wells in the Sevier Desert to discharge of the Sevier River near Juab, to cumulative departure from the average annual precipitation at Oak City, and to annual withdrawals from wells.

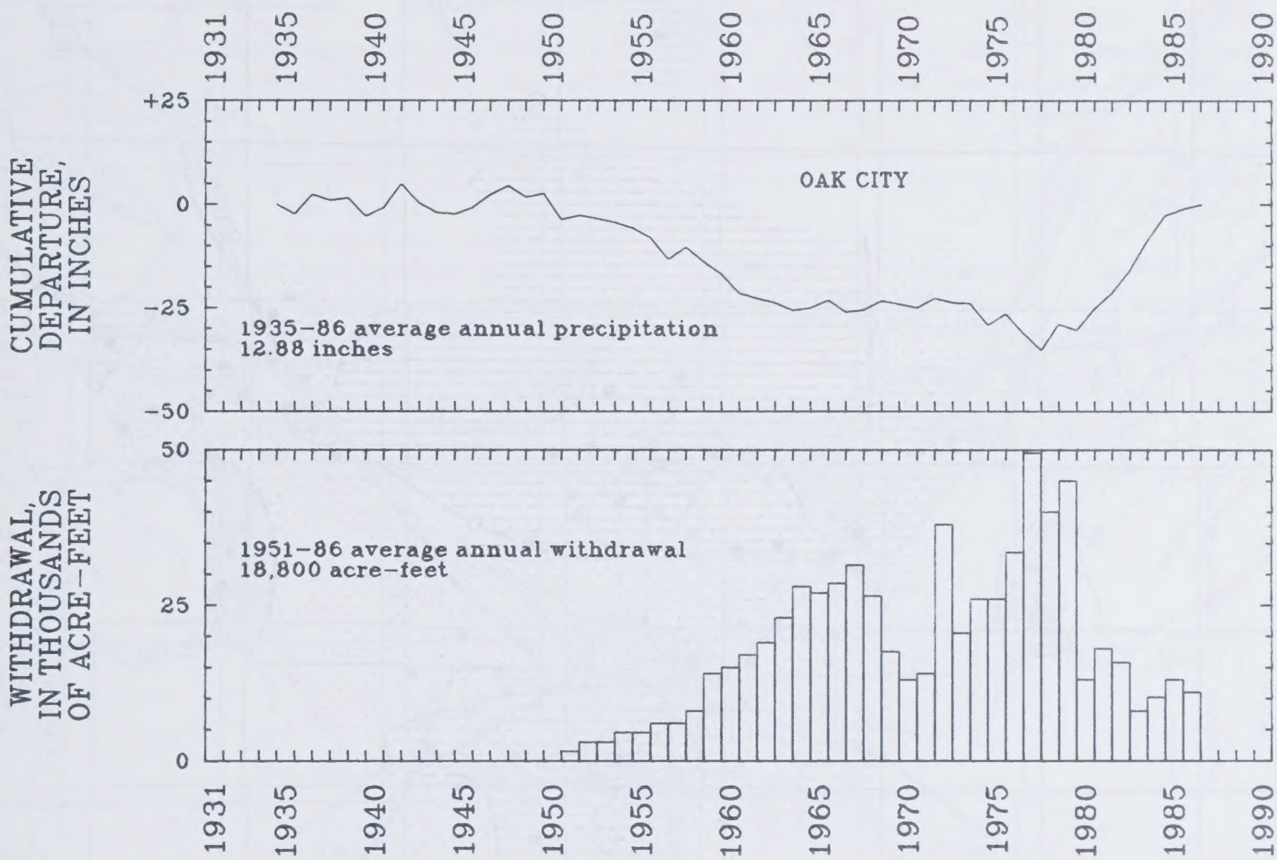


Figure 21.—Continued

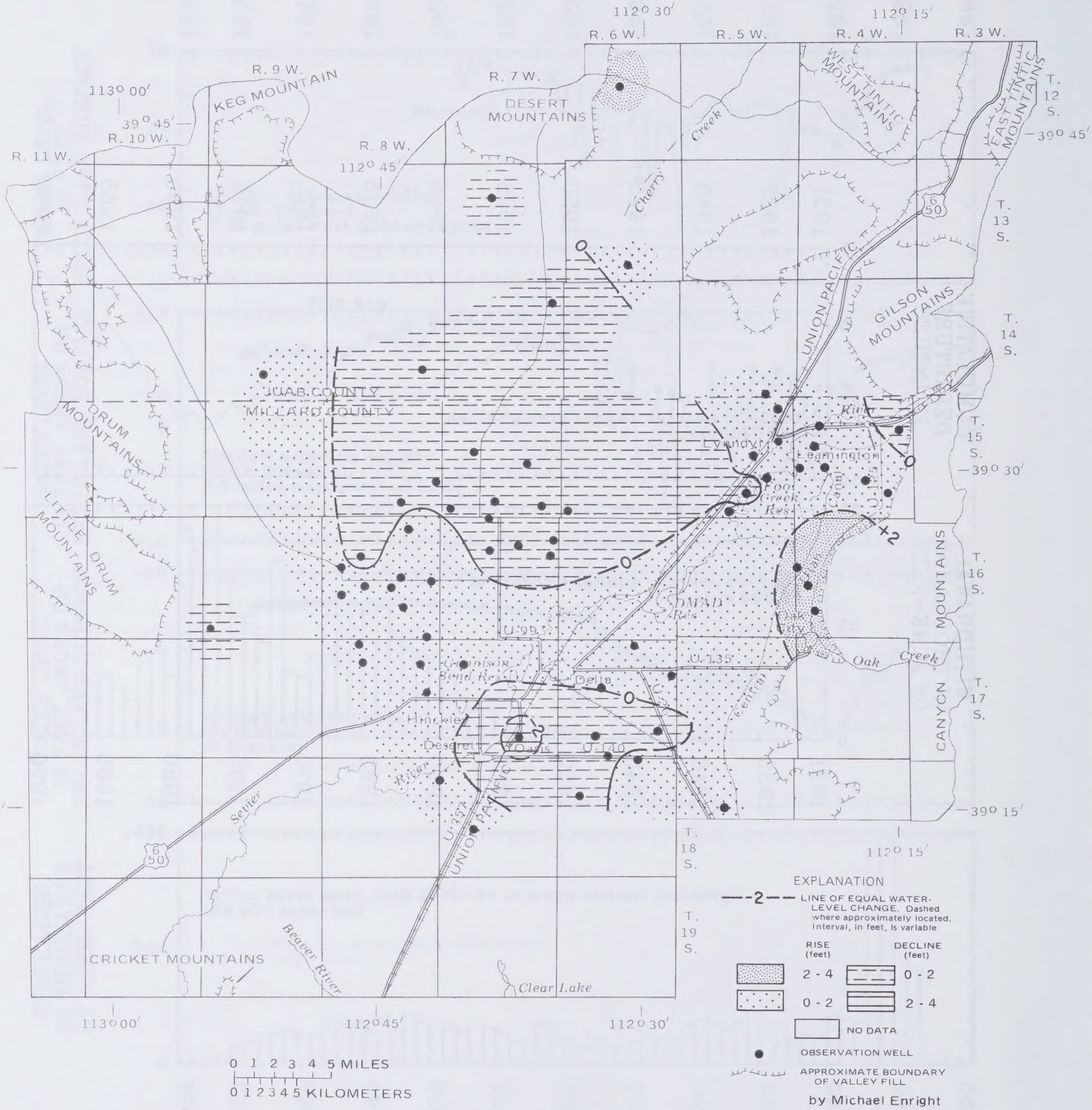


Figure 22.—Map of part of the Sevier Desert showing change of water levels in the shallow artesian aquifer from March 1986 to March 1987.

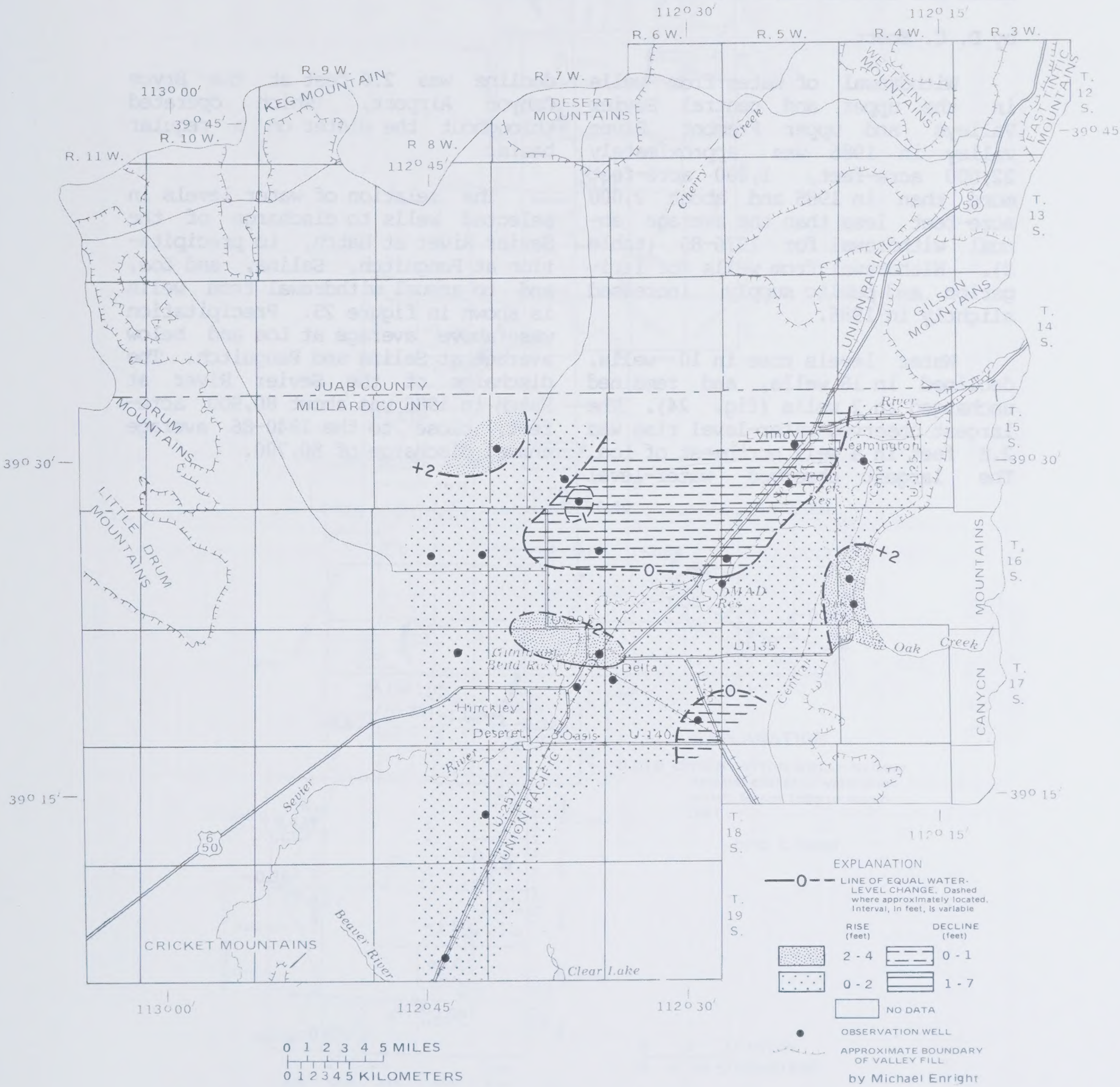


Figure 23.—Map of part of the Sevier Desert showing change of water levels in the deep artesian aquifer from March 1986 to March 1987.

## UPPER AND CENTRAL SEVIER VALLEYS AND UPPER FREMONT RIVER VALLEY

by D. C. Emett

Withdrawal of water from wells in the upper and central Sevier Valleys and upper Fremont River valley in 1986 was approximately 22,000 acre-feet, 1,000 acre-feet more than in 1985 and about 2,000 acre-feet less than the average annual withdrawal for 1976-85 (table 2). Withdrawal from wells for irrigation and public supply increased slightly in 1986.

Water levels rose in 10 wells, declined in 18 wells, and remained unchanged in 2 wells (fig. 24). The largest observed water-level rise was 2.8 feet in a well northwest of Loa. The largest observed water-level decline was 2.0 feet at the Bryce Canyon Airport, which operated throughout the winter on a regular basis.

The relation of water levels in selected wells to discharge of the Sevier River at Hatch, to precipitation at Panguitch, Salina, and Loa, and to annual withdrawal from wells is shown in figure 25. Precipitation was above average at Loa and below average at Salina and Panguitch. The discharge of the Sevier River at Hatch in 1986 was about 80,900 acre-feet, close to the 1940-86 average annual discharge of 80,700.

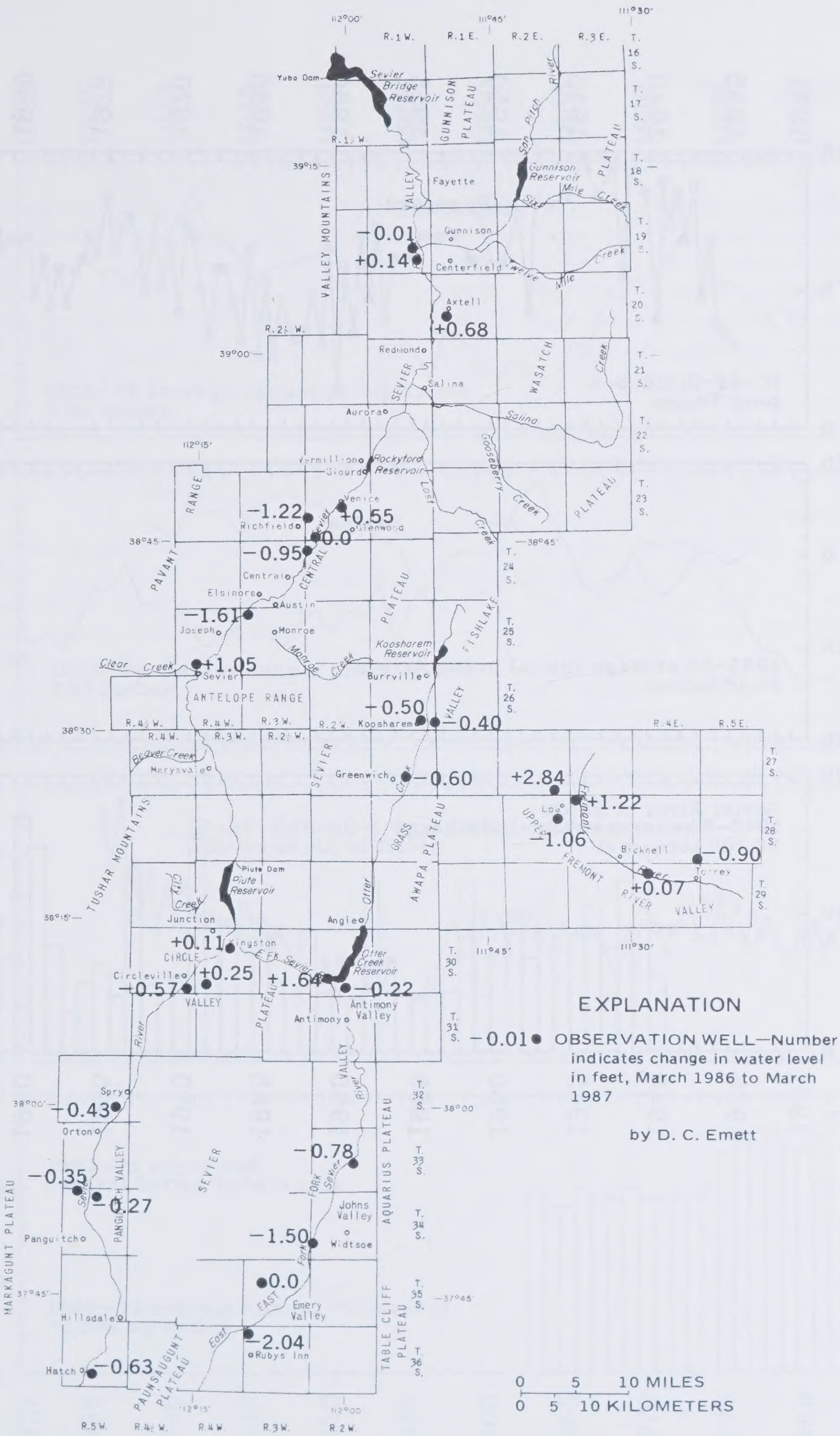


Figure 24.—Map of the upper and central Sevier Valleys and upper Fremont River valley showing change of water levels from March 1986 to March 1987.

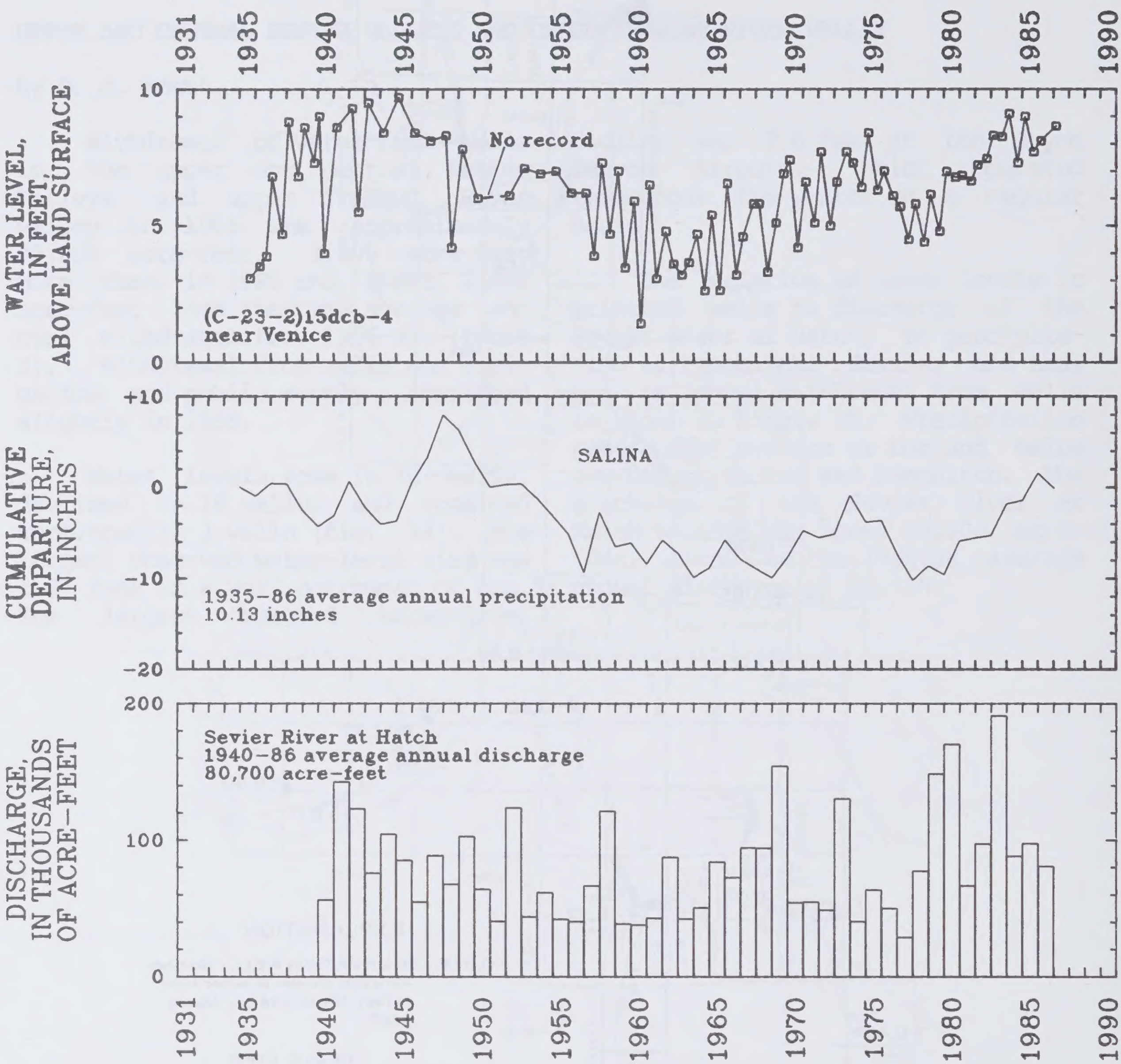


Figure 25.—Relation of water levels in selected wells to discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at selected climate stations, and to annual withdrawal from wells—upper and central Sevier Valleys and upper Fremont River valley.

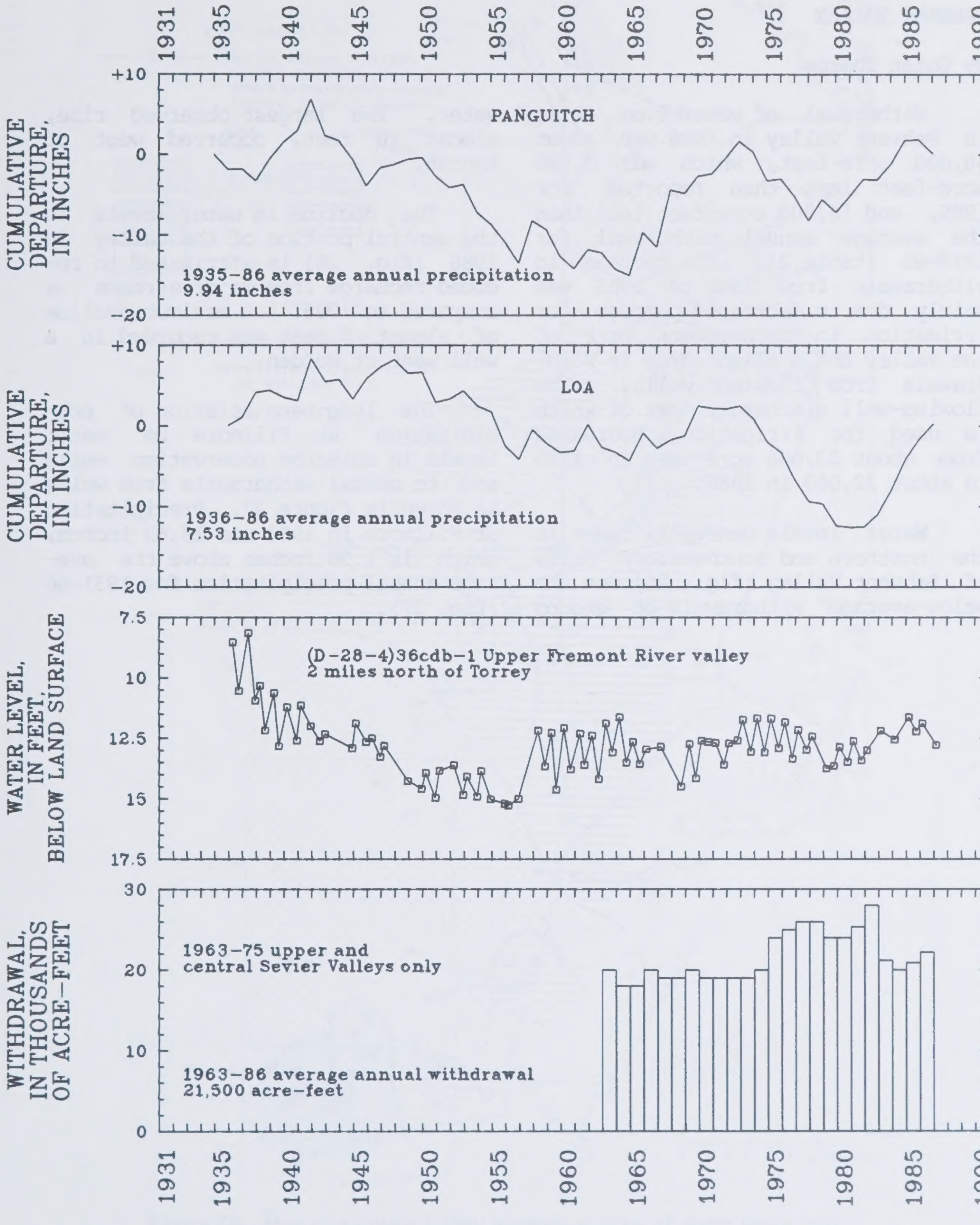


Figure 25.—Continued

## PAHVANT VALLEY

by Susan Thiros

Withdrawal of water from wells in Pahvant Valley in 1986 was about 60,000 acre-feet, which was 3,000 acre-feet less than reported for 1985, and 16,000 acre-feet less than the average annual withdrawal for 1976-85 (table 2). The decrease in withdrawals from 1985 to 1986 was mainly due to decreased pumpage for irrigation in the northern part of the valley and a slight drop in withdrawals from flowing wells. The flowing-well discharge, most of which is used for irrigation, decreased from about 23,000 acre-feet in 1985 to about 22,000 in 1986.

Water levels generally rose in the northern and southwestern parts of Pahvant Valley (fig. 26) due to below-average withdrawals of ground water. The largest observed rise, almost 10 feet, occurred west of Kanosh.

The decline in water levels in the central portion of the valley in 1986 (fig. 26) is attributed to reduced recharge from major streams as compared to 1985. A maximum decline of almost 5 feet was recorded in a well west of Holden.

The long-term relation of precipitation at Fillmore to water levels in selected observation wells and to annual withdrawals from wells is shown in figure 27. Precipitation at Fillmore in 1986 was 16.63 inches, which is 1.58 inches above the average annual precipitation for 1931-86 (fig. 27).

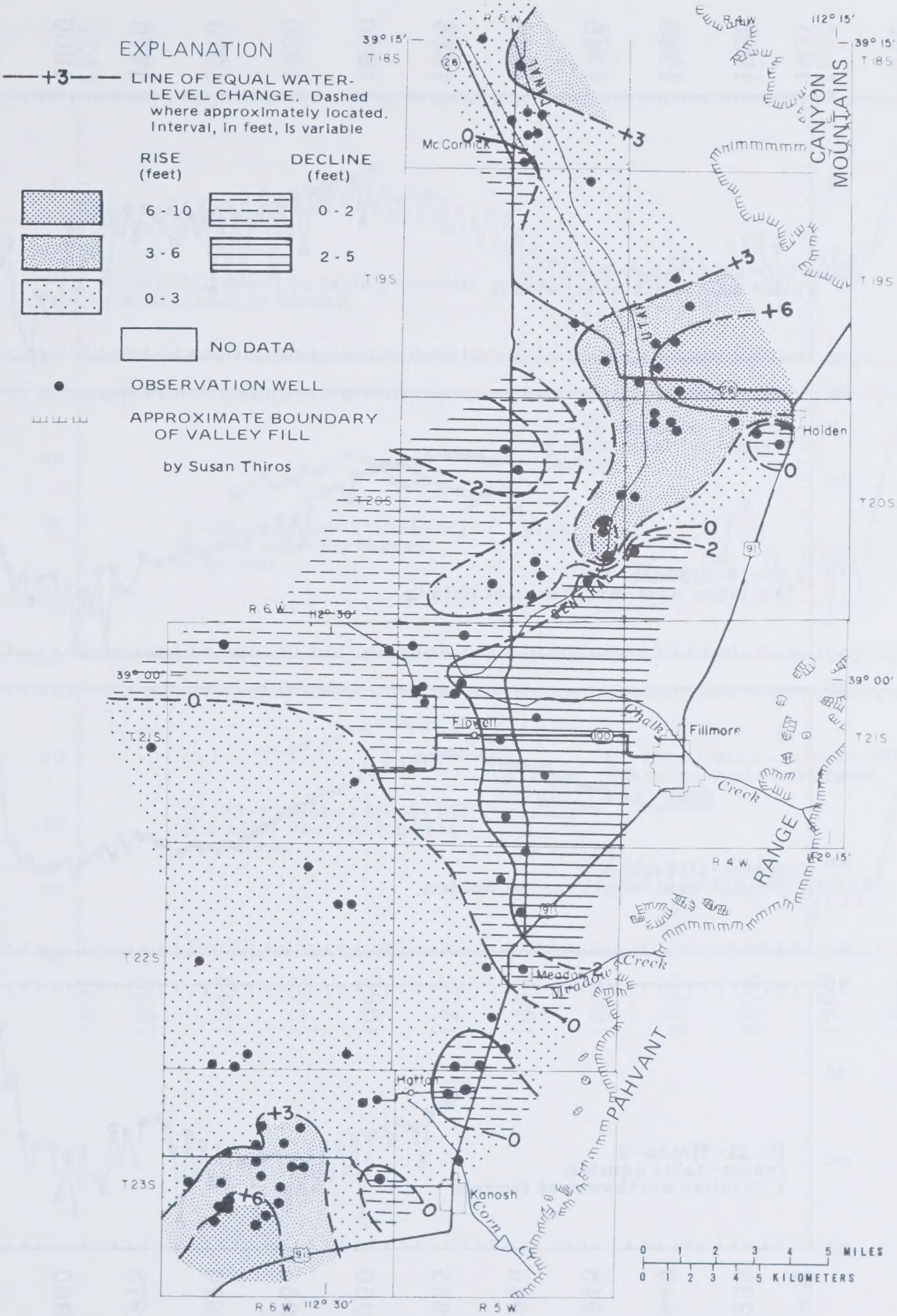


Figure 26.—Map of Pahvant Valley showing change of water levels from March 1986 to March 1987.

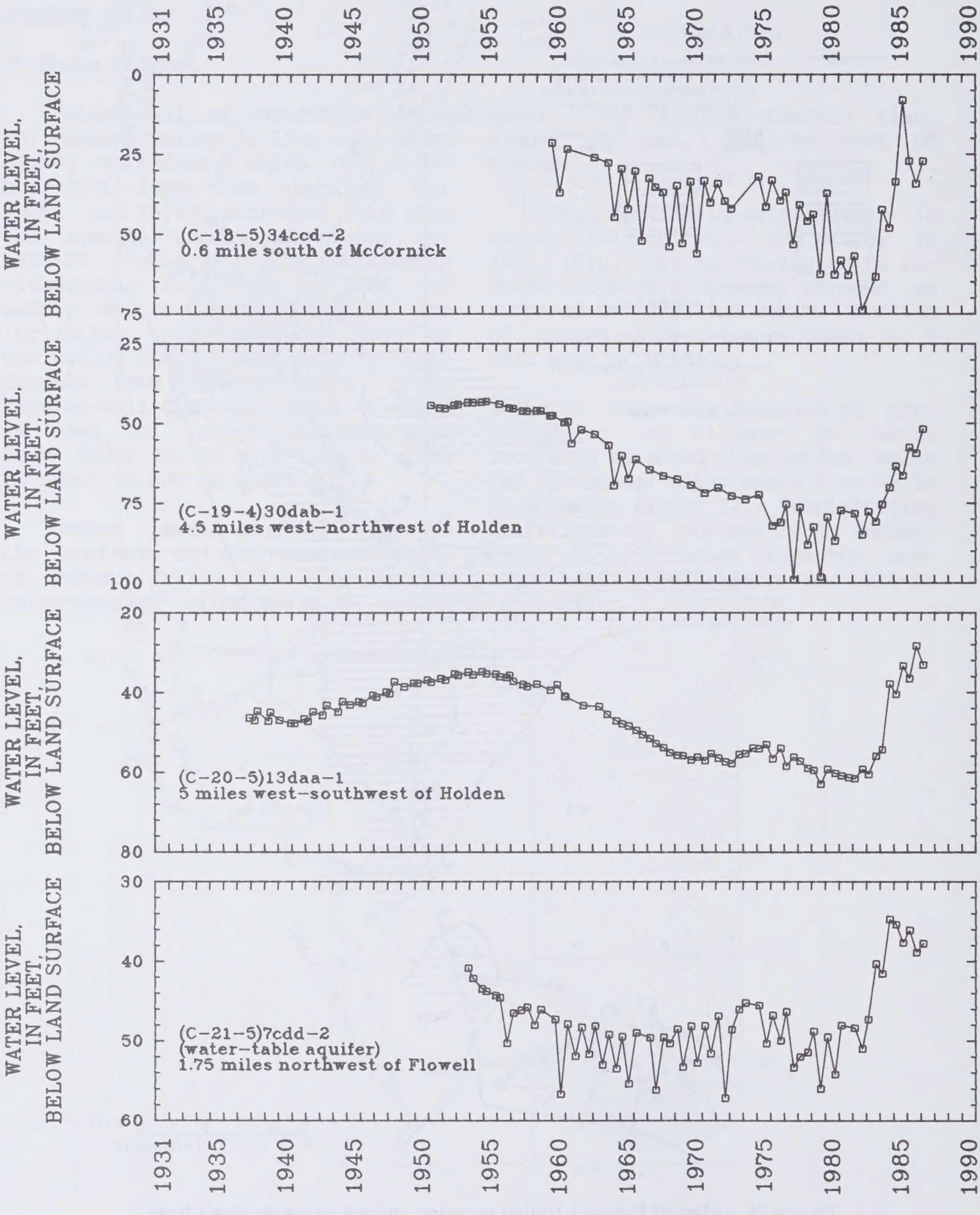


Figure 27.—Relation of water levels in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore and to annual withdrawals from wells.

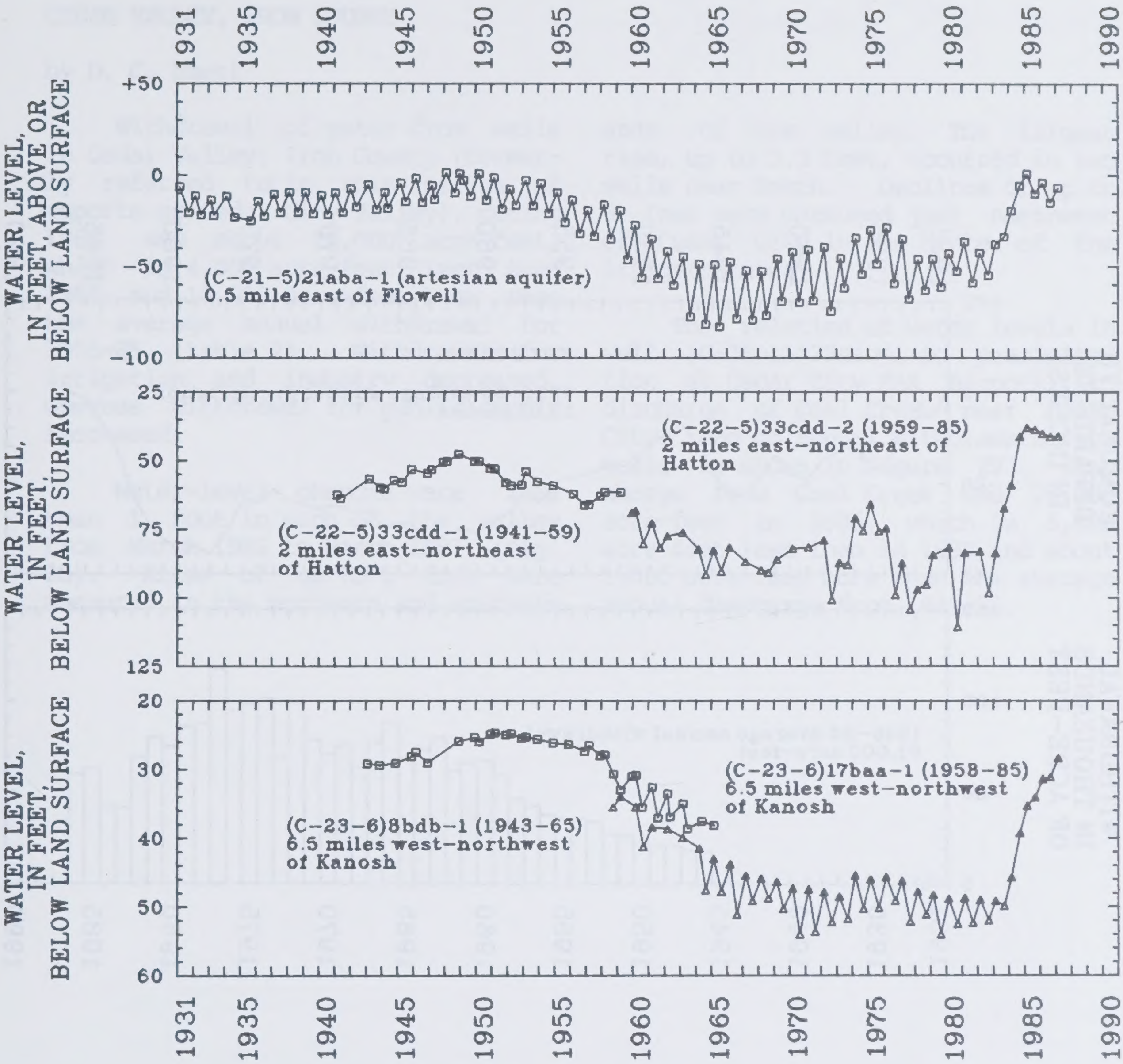


Figure 27.—Continued

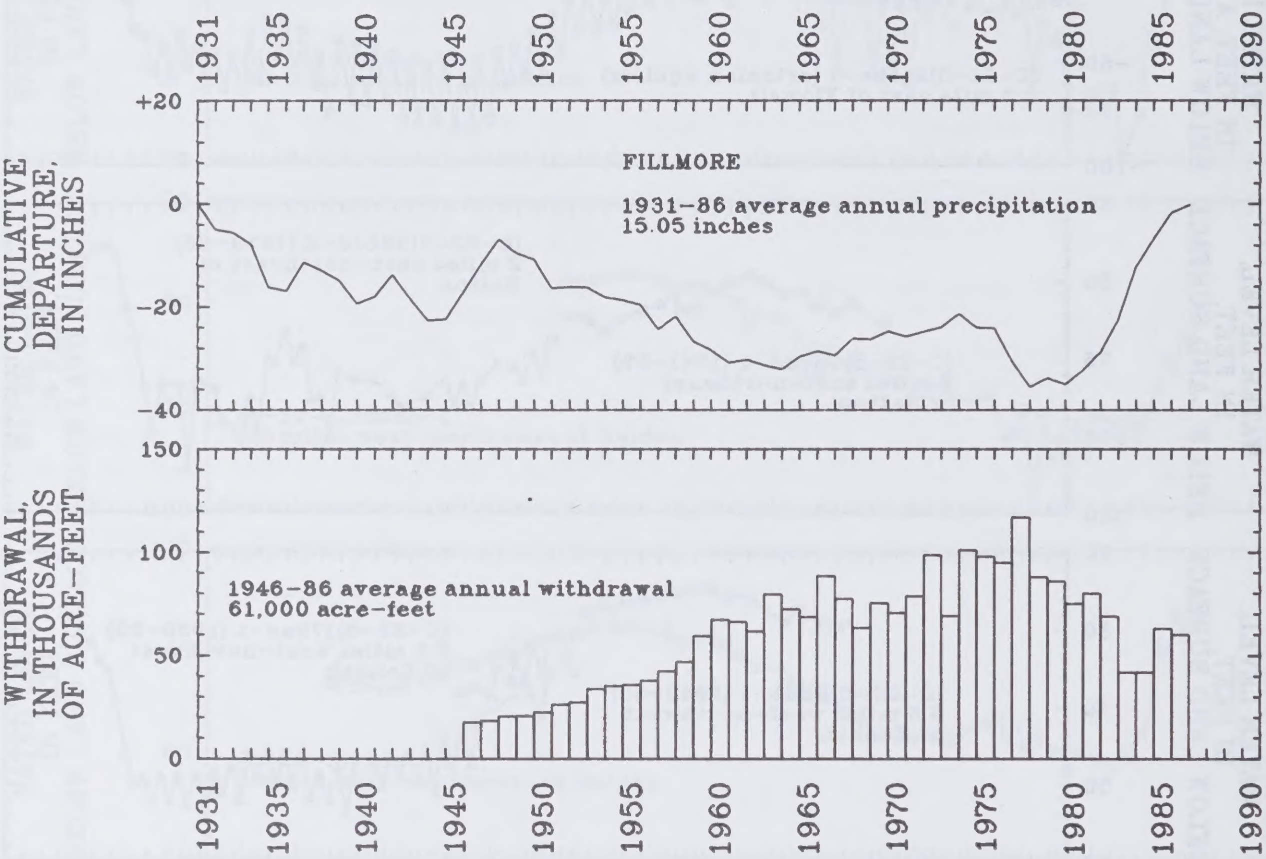


Figure 27.—Continued

## CEDAR VALLEY, IRON COUNTY

by D. C. Emett

Withdrawal of water from wells in Cedar Valley, Iron County (formerly referred to in this series of reports as Cedar City Valley), during 1986 was about 19,000 acre-feet, which is 4,000 acre-feet less than 1985 and 10,000 acre-feet less than the average annual withdrawal for 1976-85 (table 2). Withdrawals for irrigation and industry decreased, whereas withdrawal for public supply increased.

Water-level changes were less than 1 foot in much of the valley from March 1986 to March 1987 (fig. 28). Rises of up to 1 foot were measured in the northern and southern ends of the valley. The largest rise, up to 3.2 feet, occurred in two wells near Enoch. Declines of up to 3 feet were measured just northwest of Cedar City in the center of the irrigated area.

The relation of water levels in well (C-35-11)33aac-1 to precipitation at Cedar City FAA Airport, to discharge of Coal Creek near Cedar City, and to annual withdrawals from wells is shown in figure 29. Discharge from Coal Creek was 25,200 acre-feet in 1986, which is 5,600 acre-feet less than in 1985 and about 1,000 acre-feet more than the average annual discharge from 1939-86.

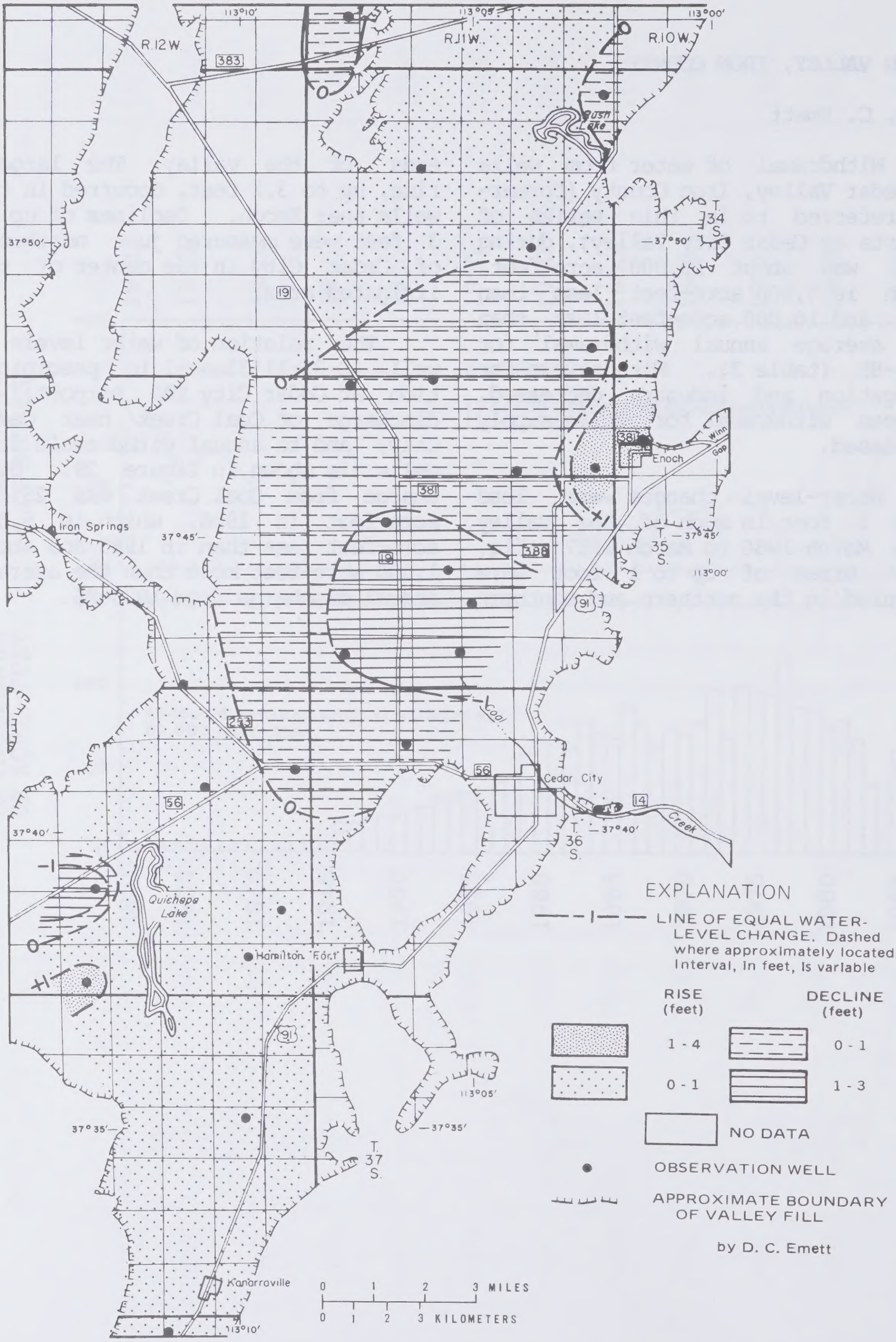


Figure 28.—Map of Cedar Valley, Iron County, showing change of water levels from March 1986 to March 1987.

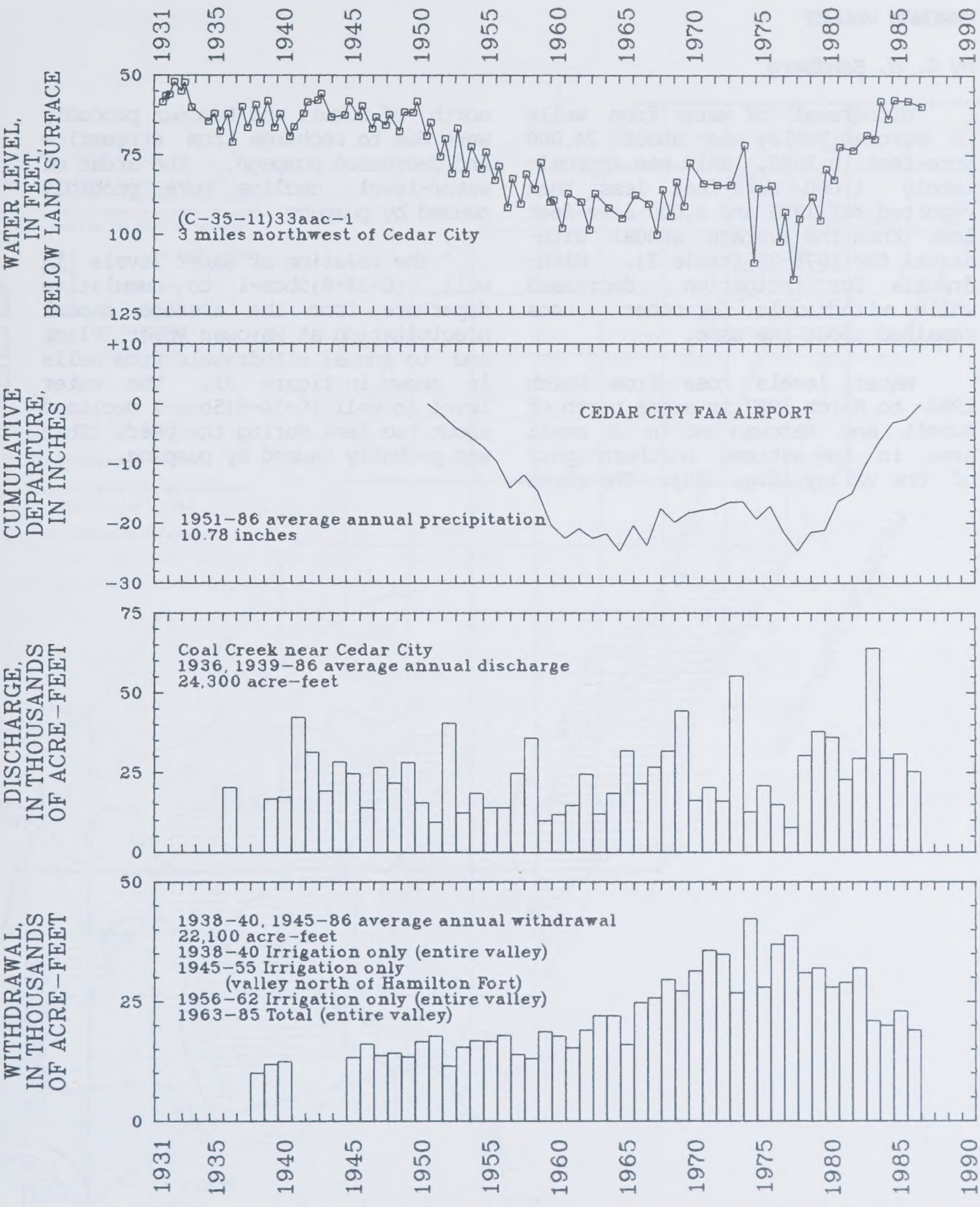


Figure 29.—Relation of water levels in well (C-35-11)33aac-1 in Cedar Valley, Iron County, to cumulative departure from the average annual precipitation at the Cedar City FAA Airport, to discharge of Coal Creek near Cedar City, and to annual withdrawals from wells.

**PAROWAN VALLEY**

by G. W. Sandberg

Withdrawal of water from wells in Parowan Valley was about 24,000 acre-feet in 1986. This was approximately 1,000 acre-feet less than reported for 1985 and 4,000 acre-feet less than the average annual withdrawal for 1976-85 (table 2). Withdrawals for irrigation decreased while withdrawals for other uses remained about the same.

Water levels rose from March 1986 to March 1987 in areas north of Summit and Parowan and in a small area in the extreme northern part of the valley (fig. 30). The rises north of Summit and Parowan probably were due to recharge from streamflow and decreased pumpage. The areas of water-level decline were probably caused by pumpage.

The relation of water levels in well (C-34-8)5bca-1 to cumulative departure from the average annual precipitation at Parowan Power Plant and to annual withdrawals from wells is shown in figure 31. The water level in well (C-34-8)5bca-1 declined about two feet during the year. This was probably caused by pumping.


Figure 30.—Map of Parowan Valley showing change of water levels from March 1986 to March 1987.

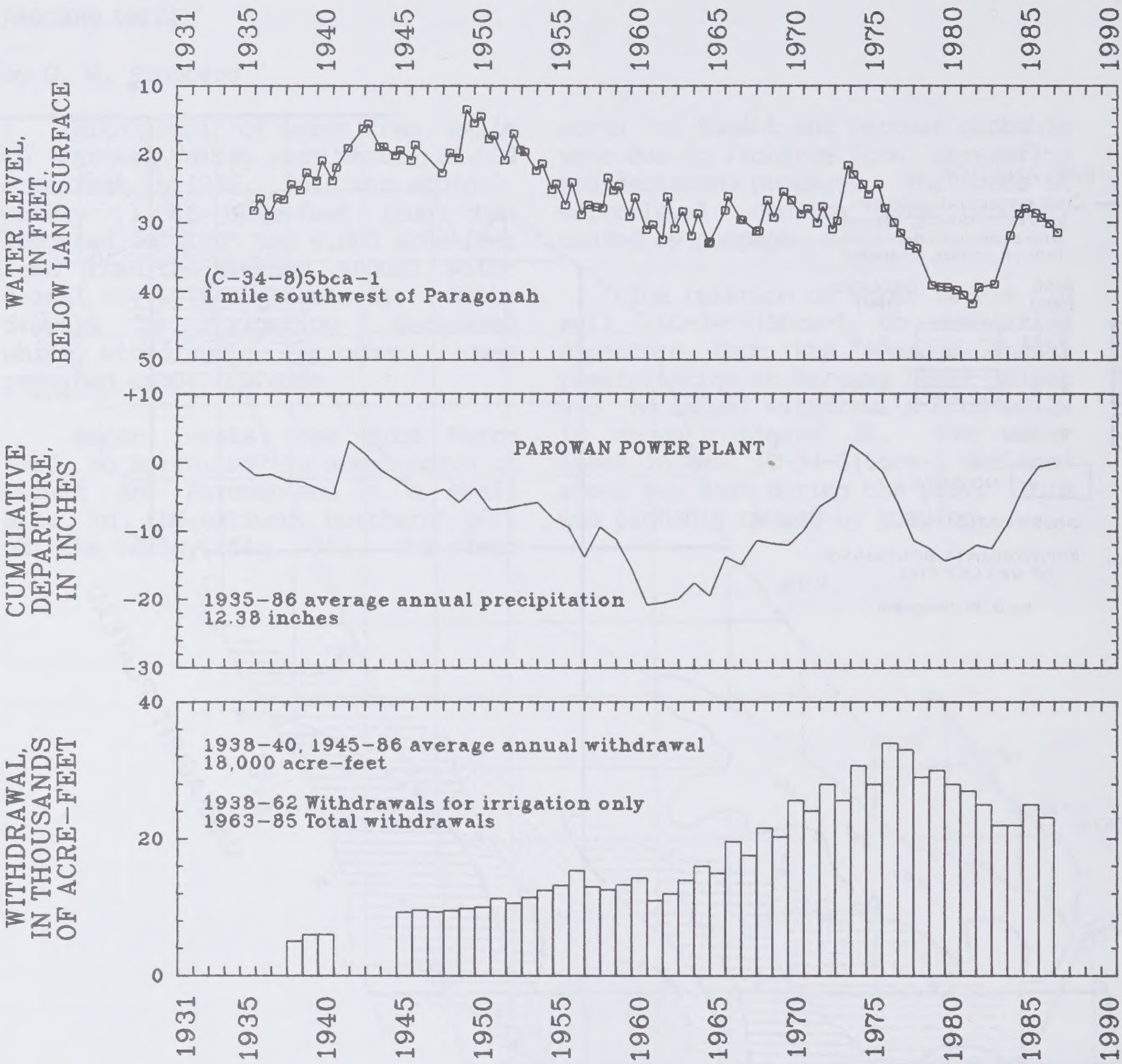


Figure 31.—Relation of water levels in well (C-34-8)5bca-1 in Parowan Valley to cumulative departure from the average annual precipitation at Parowan Power Plant and to annual withdrawals from wells.

## ESCALANTE VALLEY

### Milford area

by R. W. Puchta

Withdrawal of water from wells in the Milford area in 1986 was about 46,000 acre-feet, which is 3,000 acre-feet less than the revised 1985 withdrawal, and 8,000 acre-feet less than the 1976-85 average annual withdrawal (table 2). The discharge from the Beaver River at Rocky Ford Dam was 46,500 acre-feet in 1986, 10,600 acre-feet less than the previous year, but the fourth consecutive year it has been at least 50 percent greater than the 1931-86 average annual discharge. Because an above-average amount of surface water was available for irrigation, probably less ground water was used, resulting in below-average withdrawals.

Industrial withdrawals for geothermal-power generation for 1986 were 8,300 acre-feet, an increase of 3,000 acre-feet from the previously unpublished value for 1985. The geothermal fluids are pumped from depths of several thousand feet and approximately 85 percent of the total amount withdrawn is reinjected near the plant at depths of 1,700 feet and 3,500 feet below the land surface.

Water levels declined from March 1986 to March 1987 in most of the area in which ground water is pumped. Declines of nearly 4 feet occurred in the center of this area (fig. 32). Water levels rose slightly in an area west and northwest of Minersville and in the vicinity of Cove Creek and Antelope Spring. The water-level declines likely are related to less recharge from surface water in 1986 as compared to 1985.

The relation of water levels in wells (C-29-10)6ddc-1 and (C-29-11)13add-1 to precipitation at Milford Airport, to discharge of Beaver River at Rocky Ford Dam, and to annual withdrawals of water from wells is shown in figure 33. Precipitation at the Milford Airport for 1986 was 9.35 inches, which was 0.41 inches above the average. Well (C-29-11)13add-1 replaces as a key observation well, well (C-29-10)6ddc-2 which has been converted to a domestic supply.

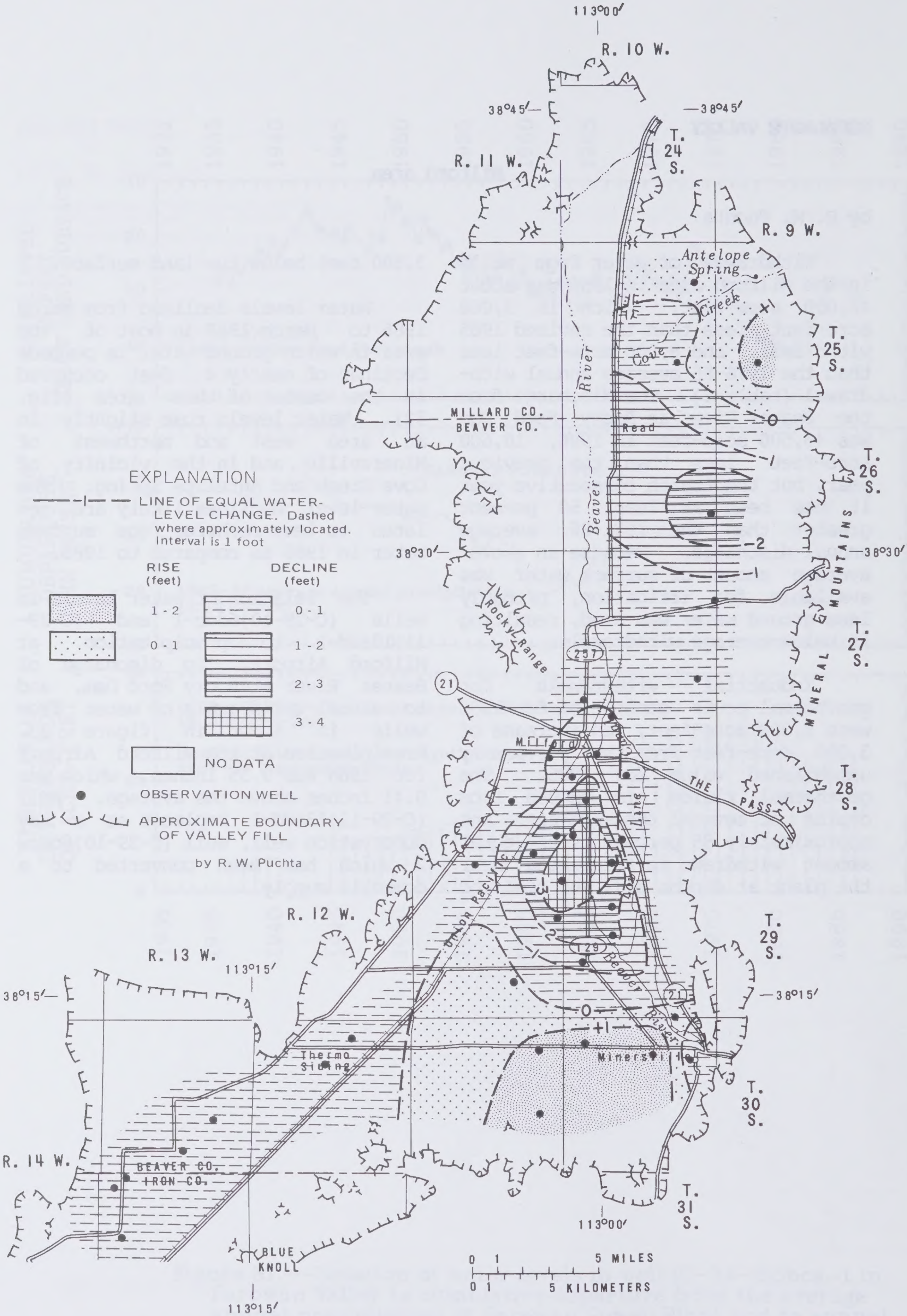


Figure 32.—Map of the Milford area showing change of water levels from March 1986 to March 1987.

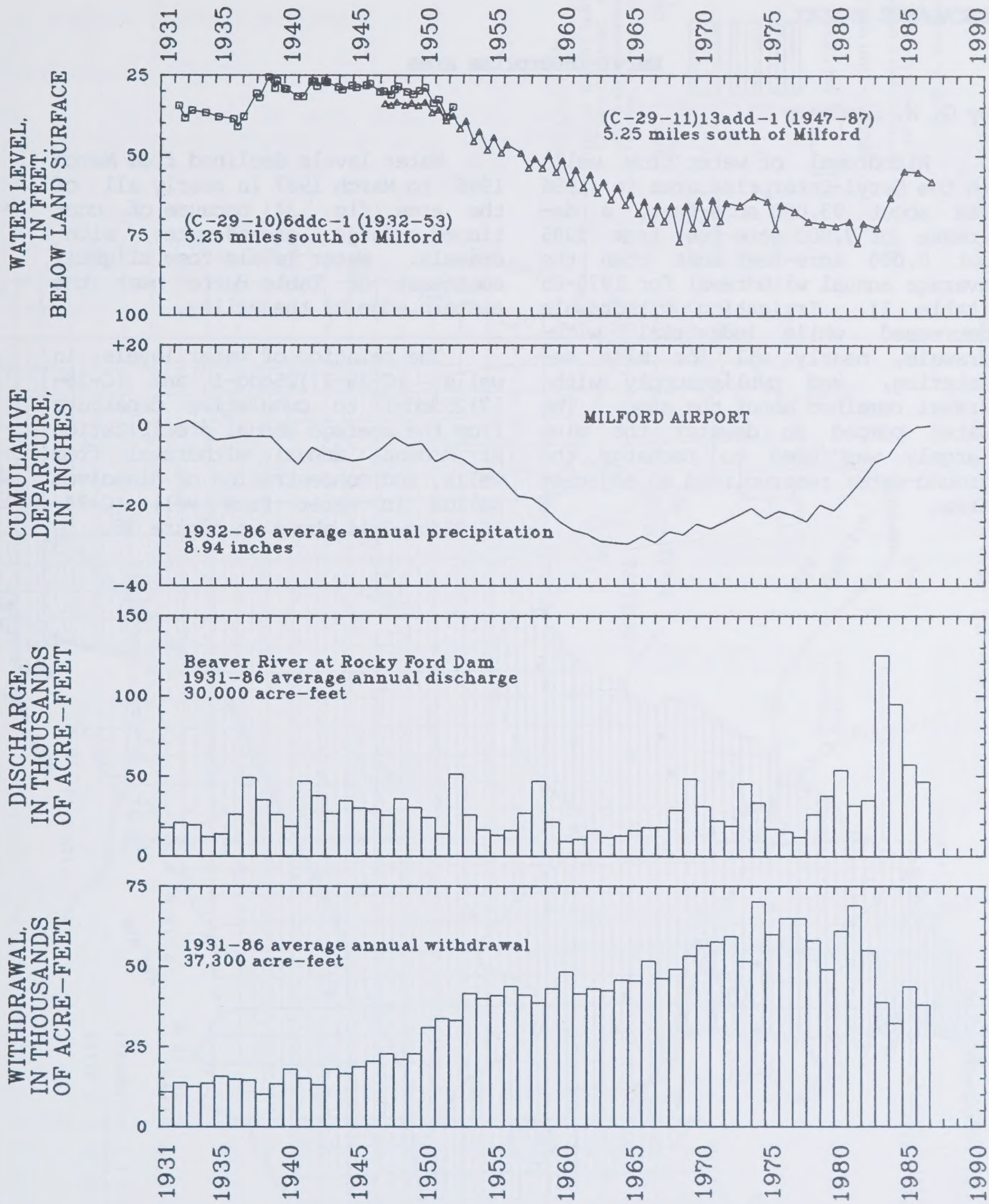


Figure 33.—Relation of water levels in wells (C-29-10)6ddc-1 and (C-29-11)13add-1 in the Milford area to cumulative departure from the average annual precipitation at Milford Airport, to discharge of the Beaver River at Rocky Ford Dam, and to annual withdrawals from wells.

## ESCALANTE VALLEY

### Beryl-Enterprise area

by G. W. Sandberg

Withdrawal of water from wells in the Beryl-Enterprise area in 1986 was about 93,000 acre-feet, a decrease of 7,000 acre-feet from 1985 but 8,000 acre-feet more than the average annual withdrawal for 1976-85 (table 2). Irrigation withdrawals decreased while industrial withdrawals, nearly all for mine dewatering, and public-supply withdrawal remained about the same. The water pumped to dewater the mine largely was used to recharge the ground-water reservoir in an adjacent area.

Water levels declined from March 1986 to March 1987 in nearly all of the area (fig. 34) because of continued large ground-water withdrawals. Water levels rose slightly southeast of Table Butte near the eastern edge of the valley.

The relation of water levels in wells (C-35-17)25cdd-1 and (C-35-17)25dcd-1 to cumulative departure from the average annual precipitation at Modena, annual withdrawal from wells, and concentration of dissolved solids in water from well (C-34-16)28dcc-2 is shown in figure 35.


Figure 34.—Map of the Beryl-Enterprise area showing change of water levels from March 1986 to March 1987.

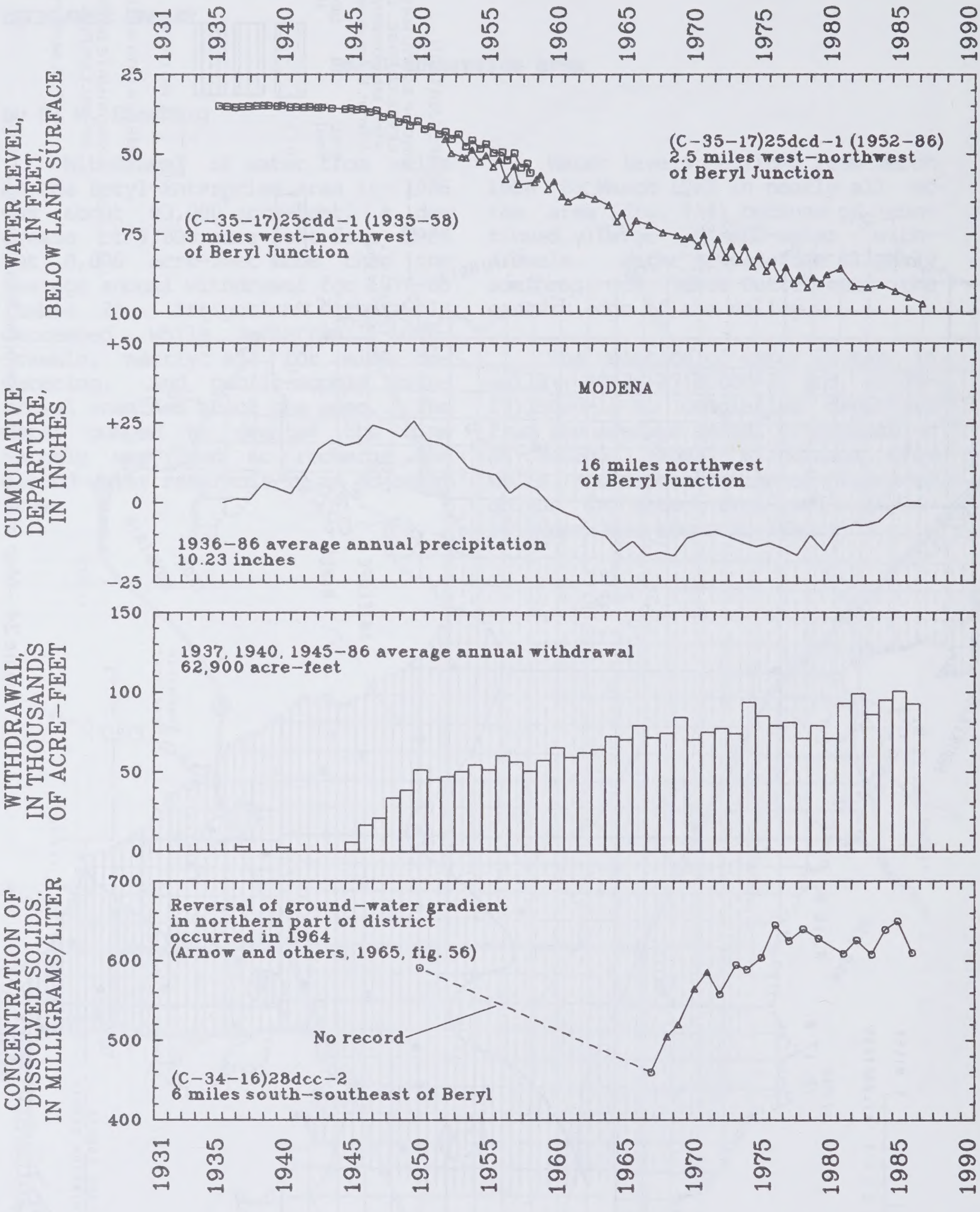


Figure 35.—Relation of water levels in wells (C-35-17)25cdd-1 and (C-35-17)25dcd-1 in the Beryl-Enterprise area to cumulative departure from the average annual precipitation at Modena, to annual withdrawals from wells, and to concentration of dissolved solids in well (C-34-16)28dcc-2.

## CENTRAL VIRGIN RIVER AREA

by G. W. Sandberg

Withdrawal of water from wells in the Central Virgin River area was approximately 20,000 acre-feet in 1986, 1,000 acre-feet less than reported for 1985 and equal to the average annual withdrawal for 1976-85 (table 2). Use for irrigation decreased 2,300 acre-feet while use for public supply increased 1,500 acre-feet. The decrease in irrigation withdrawal probably is due to a change in land use from agricultural to urban. The increase in withdrawal for public supply is due to increased population and larger urban areas.

Water levels rose in most of the central part of the Central Virgin River area and declined in the southern, northwestern, and northeastern parts (fig. 36). The largest observed rise, 5.8 feet, occurred about 5 miles southeast of St. George, and the largest decline, 7.7 feet, occurred about 15 miles northwest of St. George.

The relation of water levels in selected wells to discharge of the Virgin River at Virgin and precipitation at St. George is shown in figure 37. Precipitation was below average for the third consecutive year after six years of above average precipitation, and average discharge of the Virgin River at Virgin was about 114,200 acre-feet, which was about 21,000 acre-feet below the long-term average.

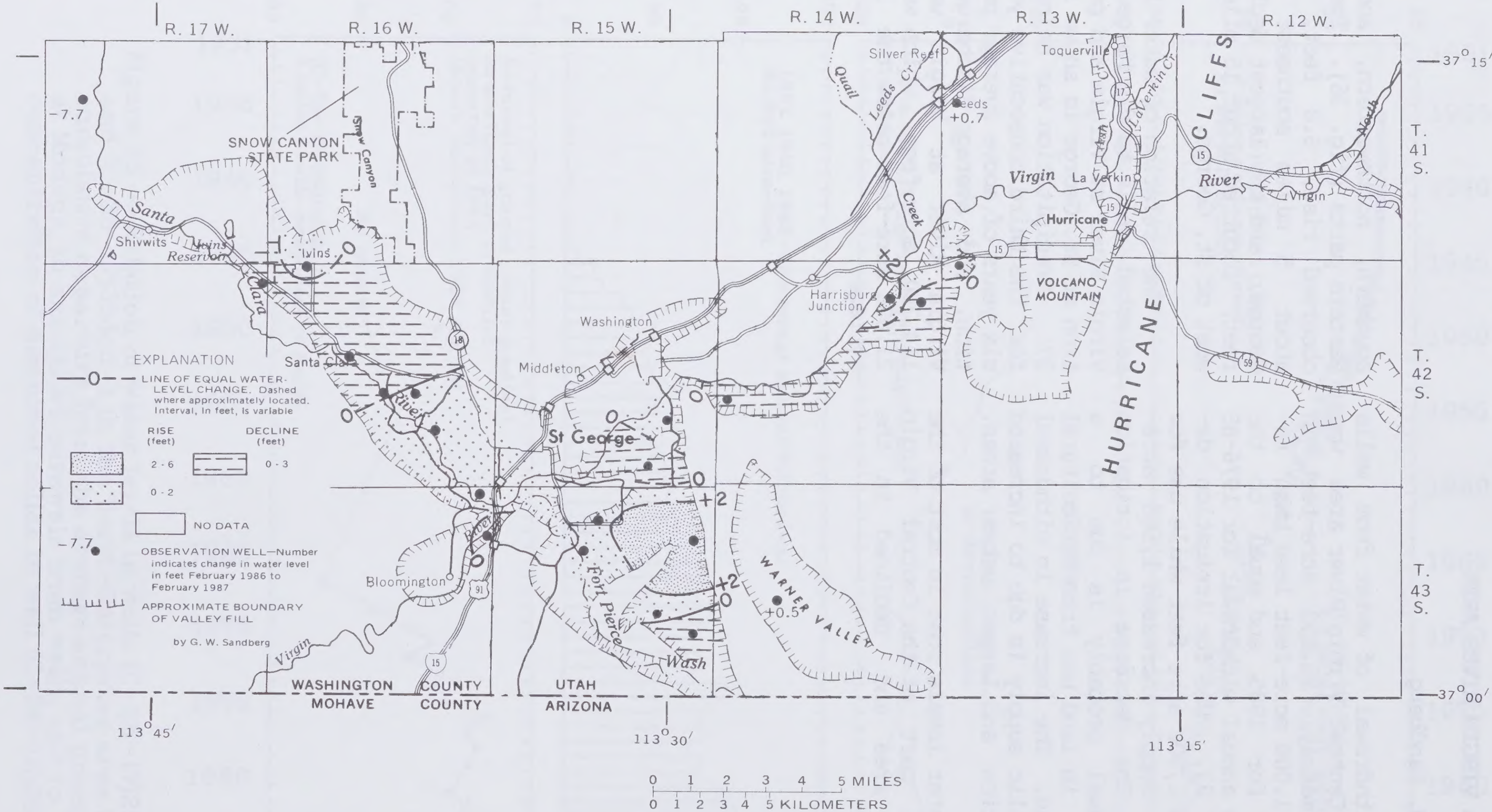


Figure 36.—Map of the Central Virgin River area showing change of water levels from February 1986 to February 1987.

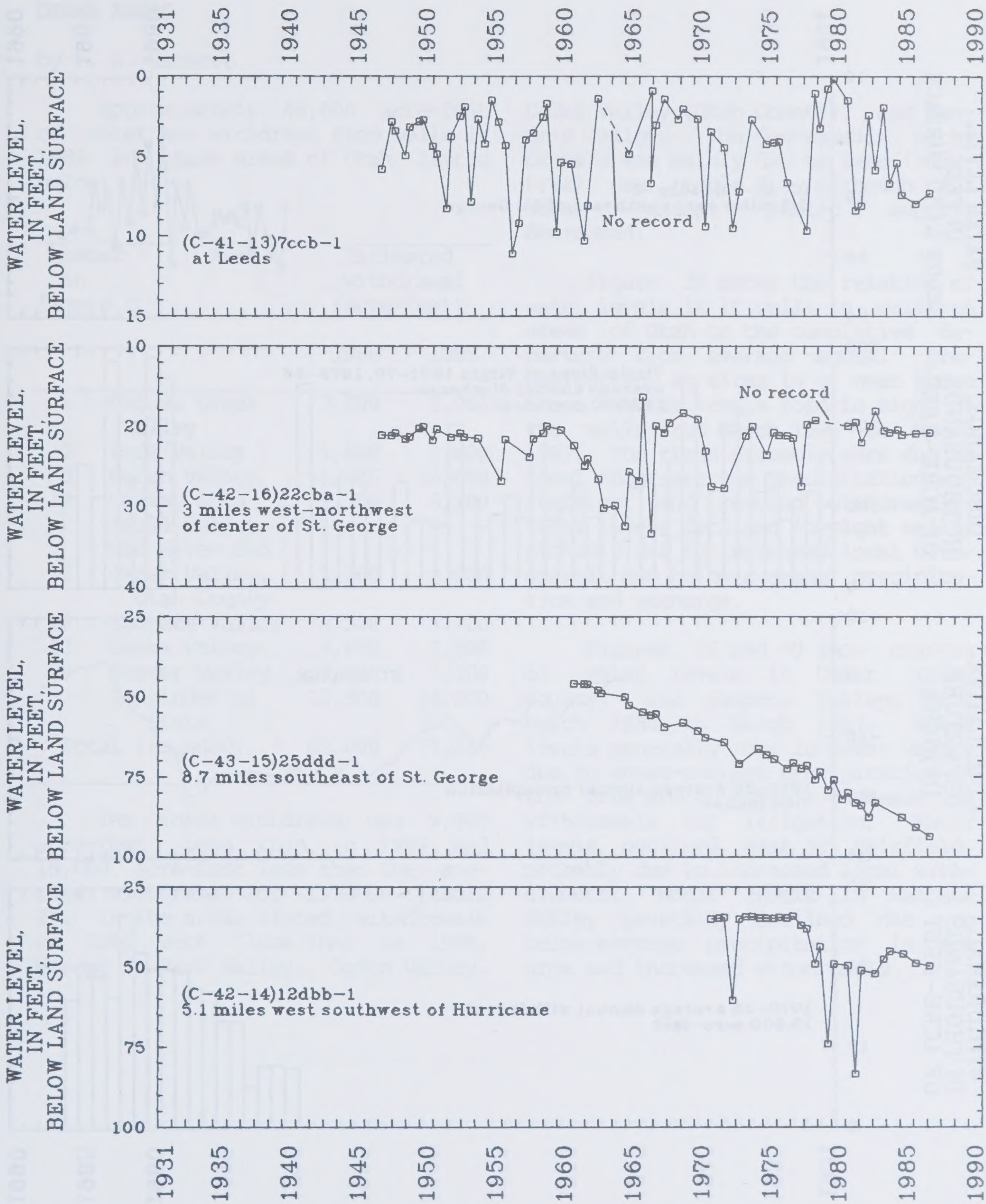


Figure 37.—Relation of water levels in selected wells to discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, and to annual withdrawals from wells in the Central Virgin River area.

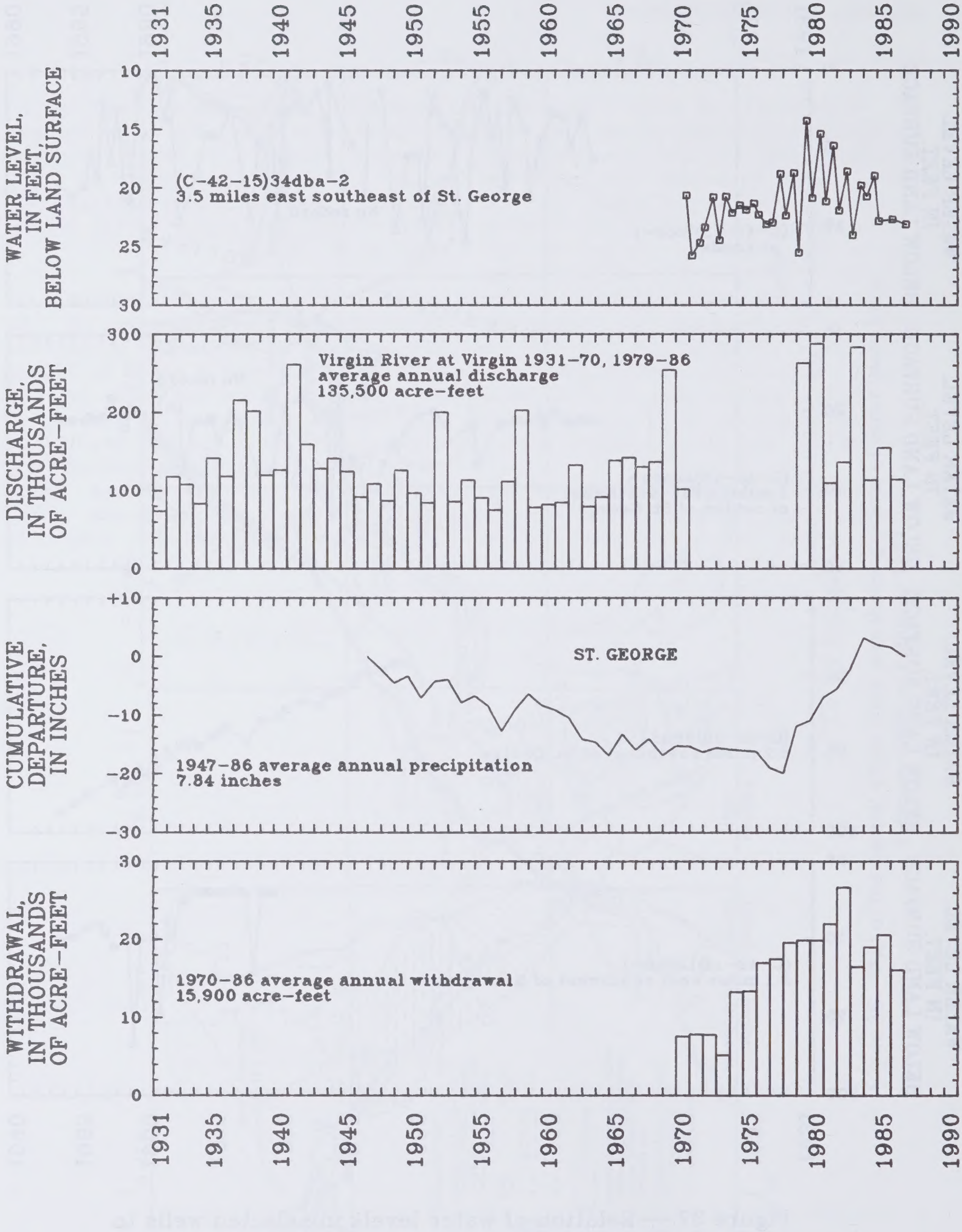


Figure 37.—Continued

## OTHER AREAS

by L. R. Herbert

Approximately 68,000 acre-feet of water was withdrawn from wells in 1986 in those areas of Utah listed below:

| Number in figure 1 | Area | Estimated withdrawal (acre-feet) 1986 | 1985 |
|---|---|---|---|
| 1 | Grouse Creek Valley | 2,200 | 3,000 |
| 2 | Park Valley | 1,800 | 1,600 |
| 8 | Ogden Valley | 10,800 | 10,000 |
| 12 | Dugway area Skull Valley Old River Bed | 5,200 | 6,100 |
| 13 | Cedar Valley, Utah County | 2,200 | 2,000 |
| 18 | Sanpete Valley | 8,300 | 5,100 |
| 23 | Snake Valley | 4,600 | 7,800 |
| 25 | Beaver Valley | 7,000 | 7,200 |
| | Remainder of State | 25,900 | 34,500 |
| | Total (rounded) | 68,000 | 77,000 |

The total withdrawal was 9,000 acre-feet less than in 1985 and 15,000 acre-feet less than the average withdrawal for 1976-85 (table 2). In the areas listed, withdrawals in 1986 were less than in 1985, except in Park Valley, Ogden Valley, Cedar Valley (Utah County), and Sanpete Valley. The decrease in withdrawals was mainly due to less industrial use (table 2), although all uses, except public supply, decreased.

Figure 38 shows the relation of water levels in 16 wells in selected areas of Utah to the cumulative departure from average annual precipitation at sites in or near those areas. Water levels rose in eight of the wells from March 1986 to March 1987. The rises probably were due to local above-average precipitation and recharge and reduced withdrawals. Water levels declined in eight wells, probably due to increased local withdrawals and below-average precipitation and recharge.

Figures 39 and 40 show changes of water levels in Cedar (Utah County) and Sanpete Valleys from March 1986 to March 1987. Water levels generally rose in Cedar Valley due to above-average precipitation in the area and an overall decrease in withdrawals for irrigation. Water levels declined east of Fairfield, probably due to increased local withdrawals. Water levels in Sanpete Valley generally declined due to below-average precipitation in the area and increased withdrawals.

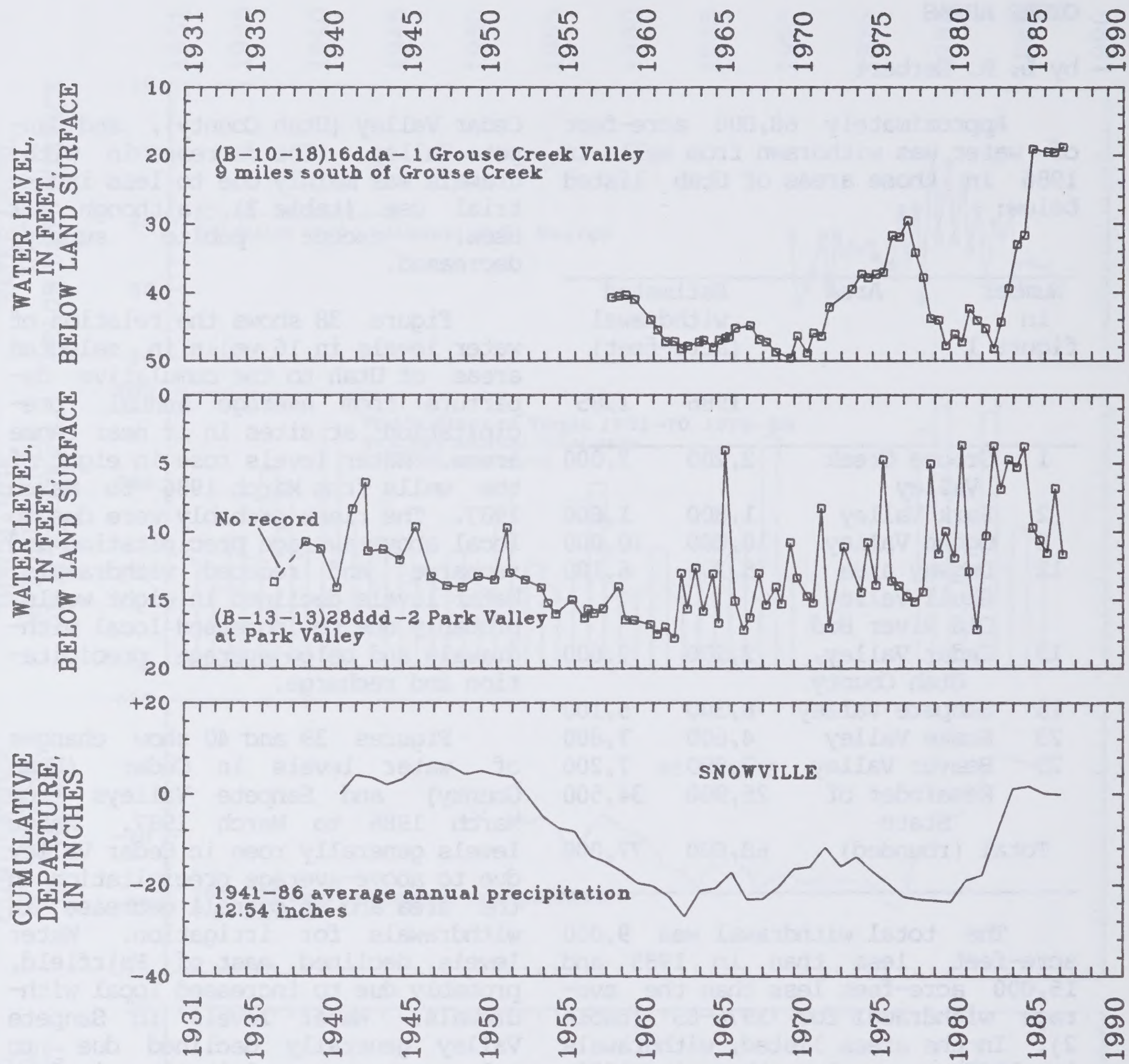


Figure 38.—Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas.

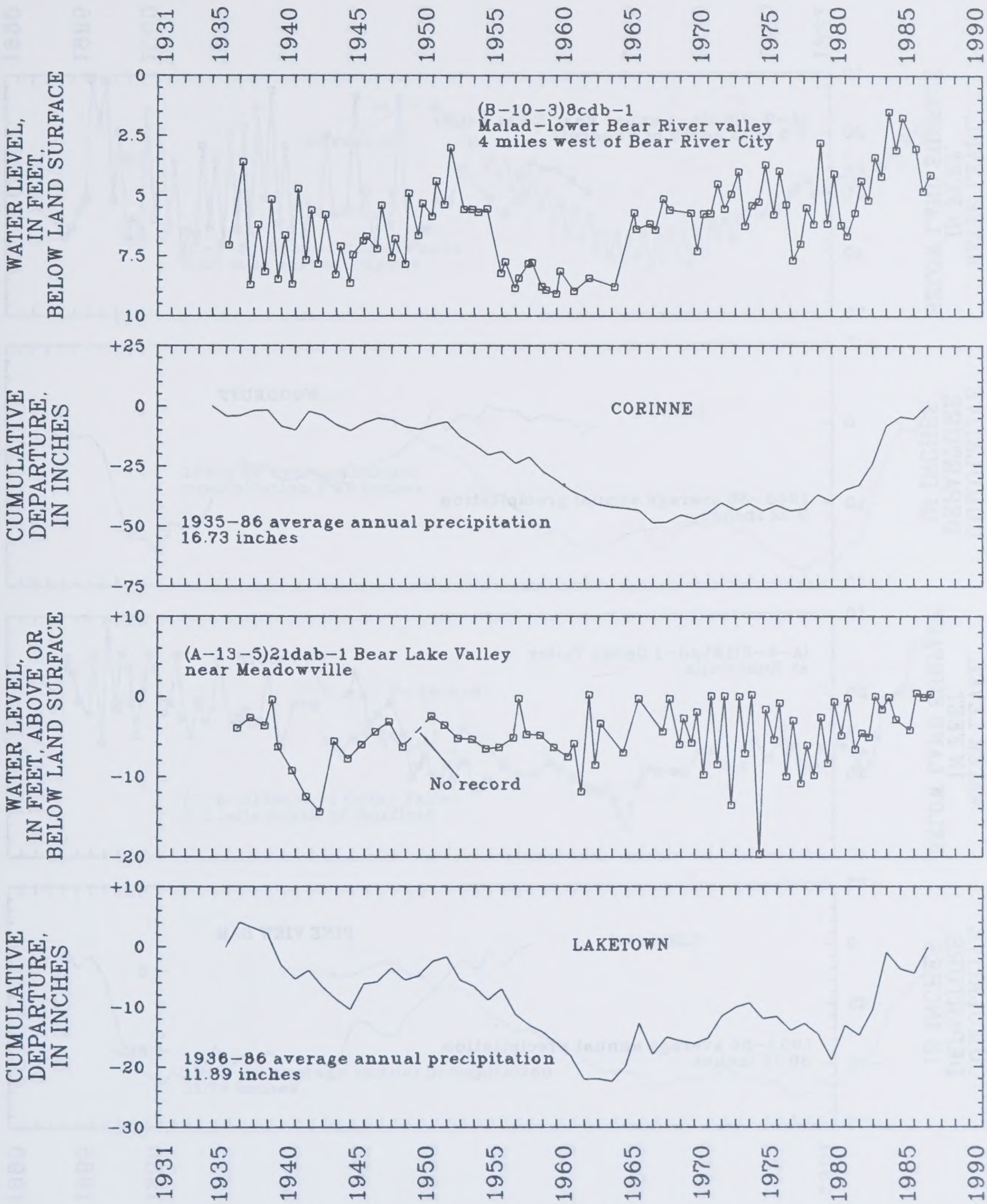


Figure 38.—Continued

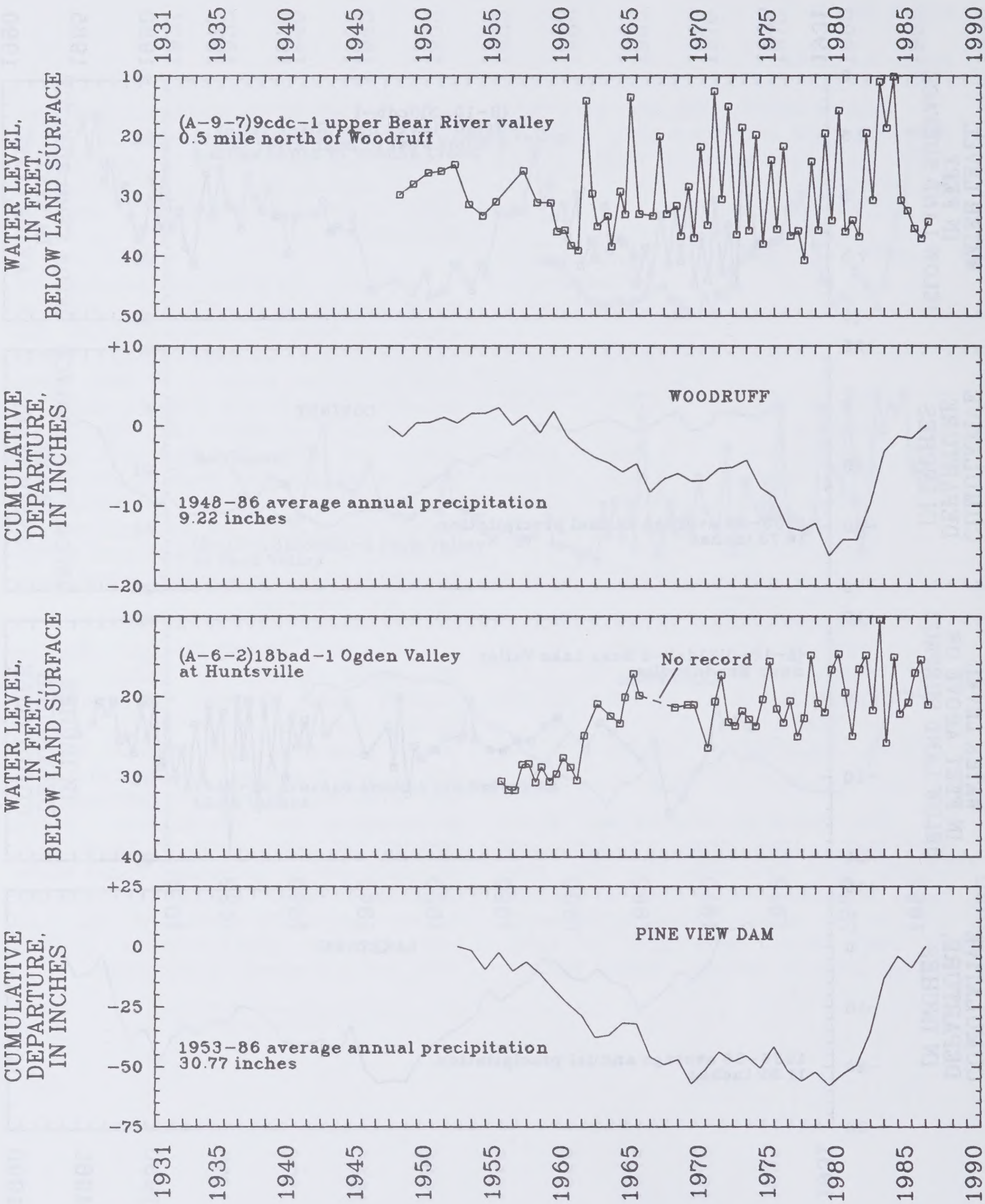


Figure 38.—Continued

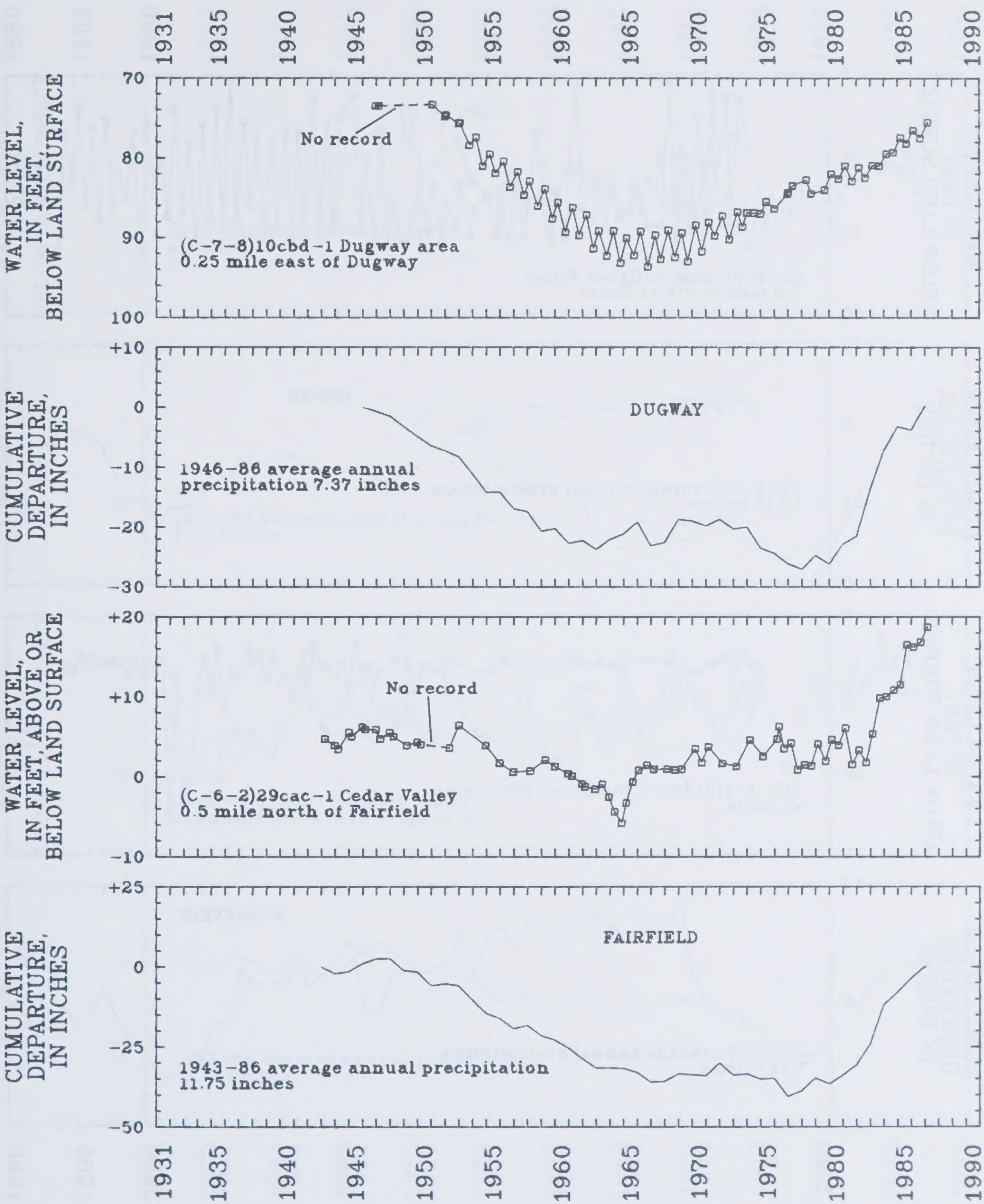


Figure 38.—Continued

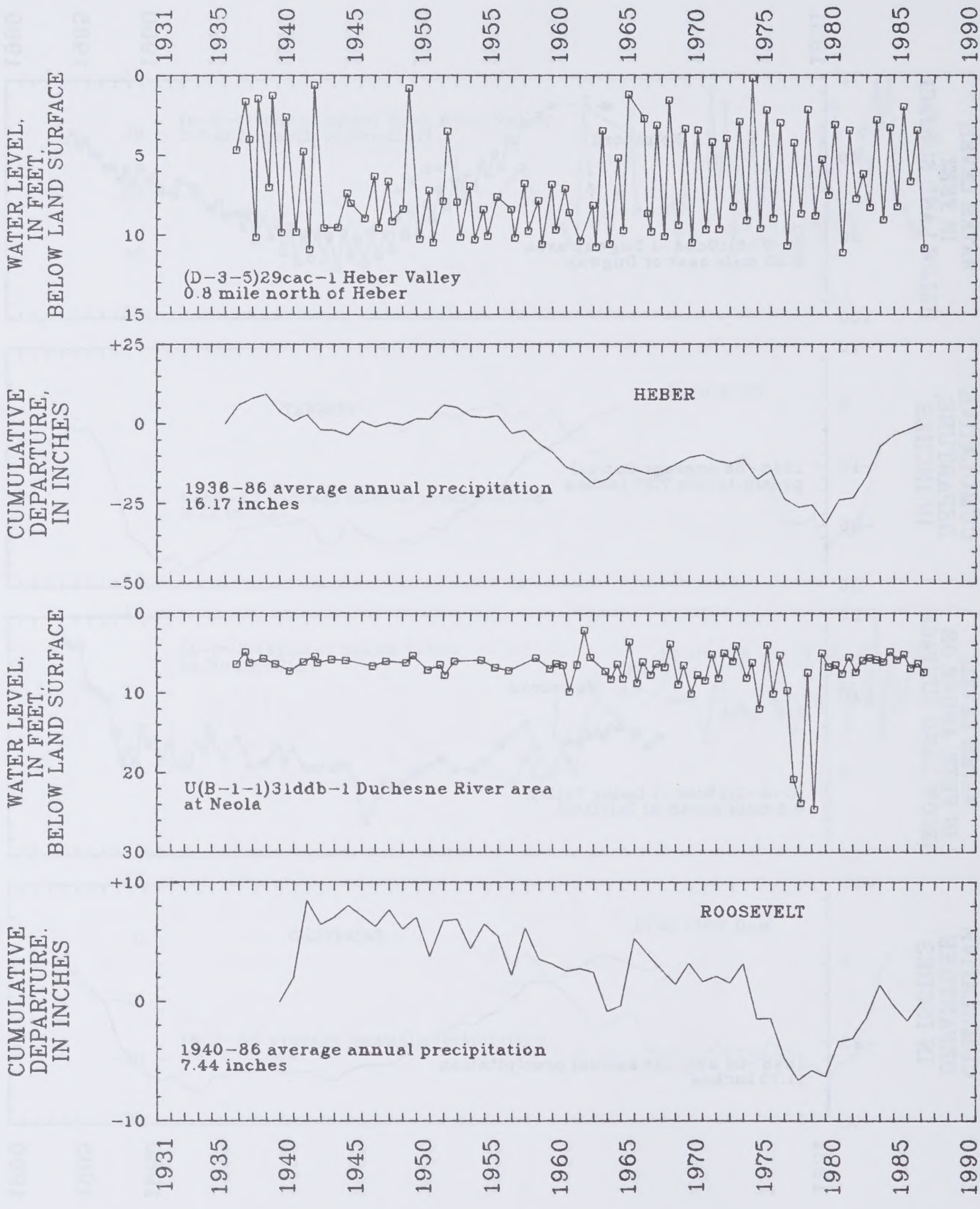


Figure 38.—Continued

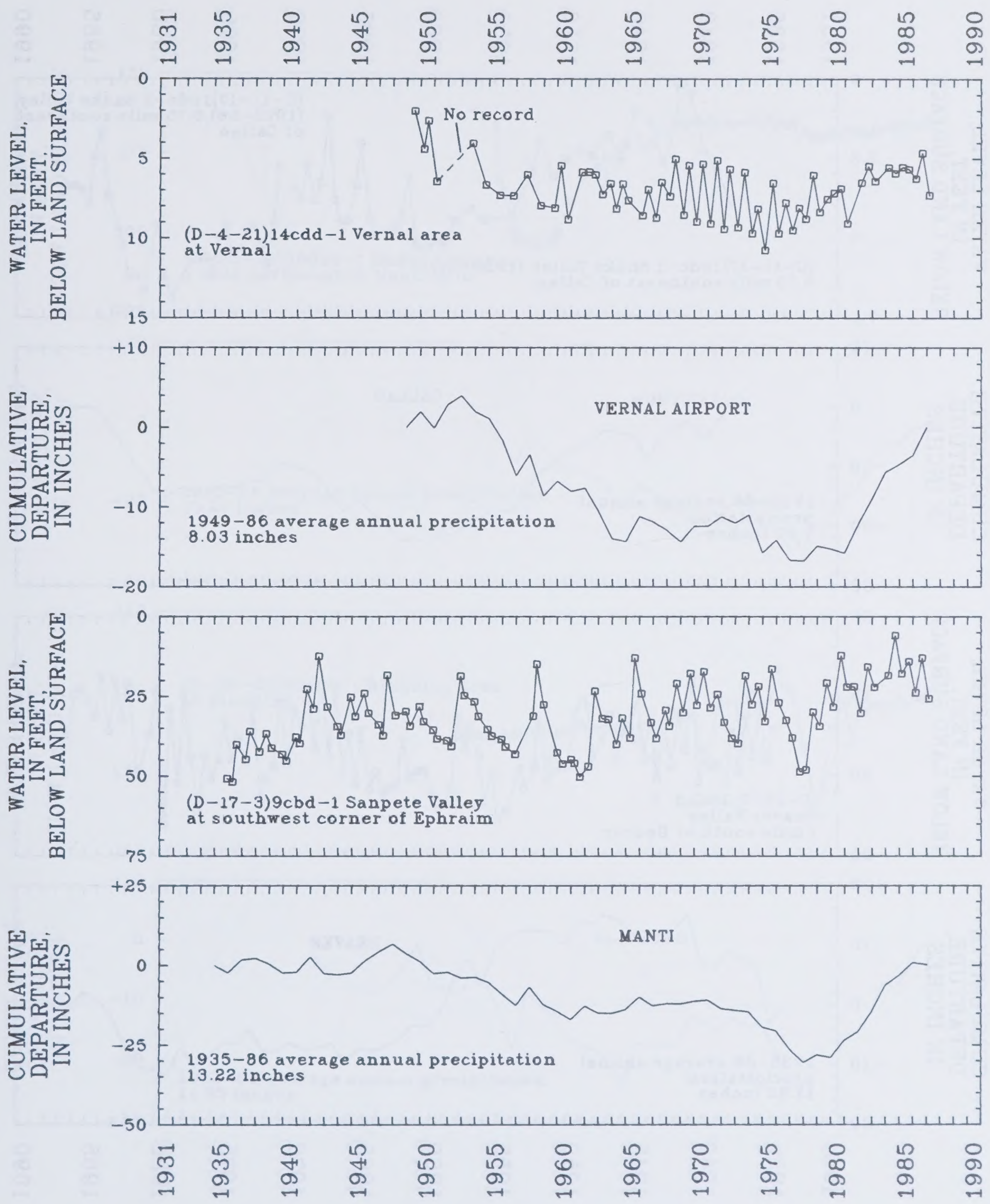


Figure 38.—Continued

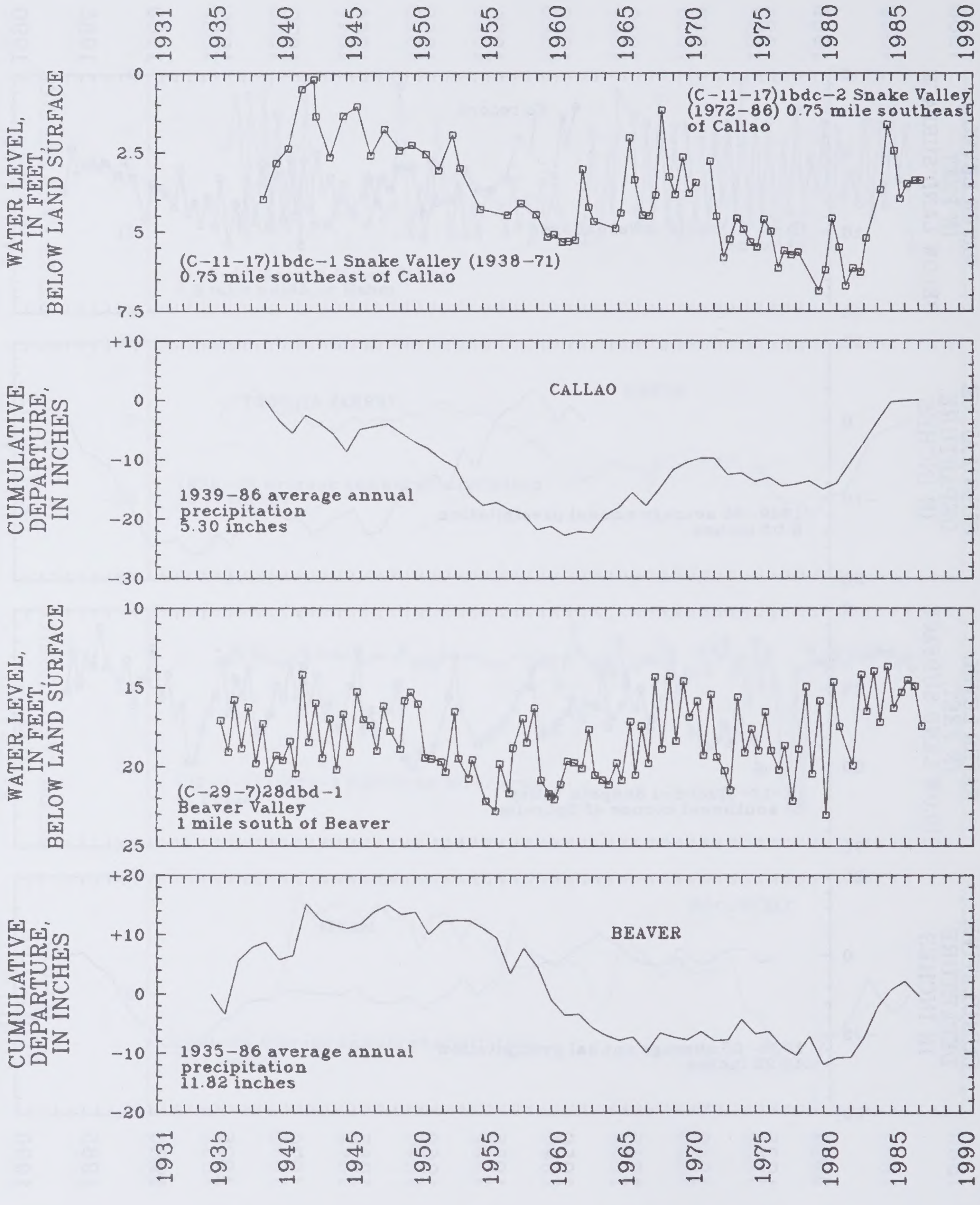


Figure 38.—Continued

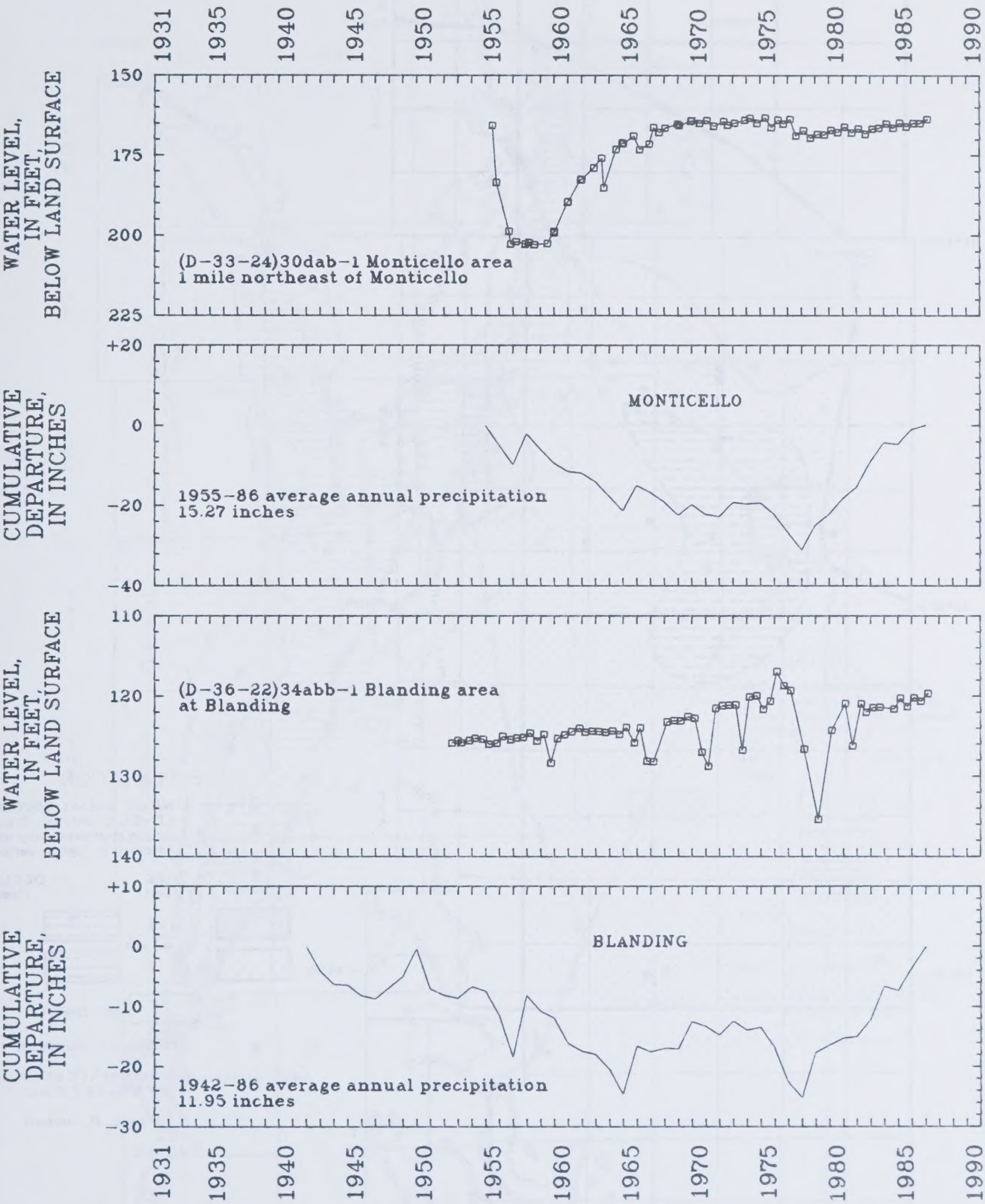


Figure 38.—Continued

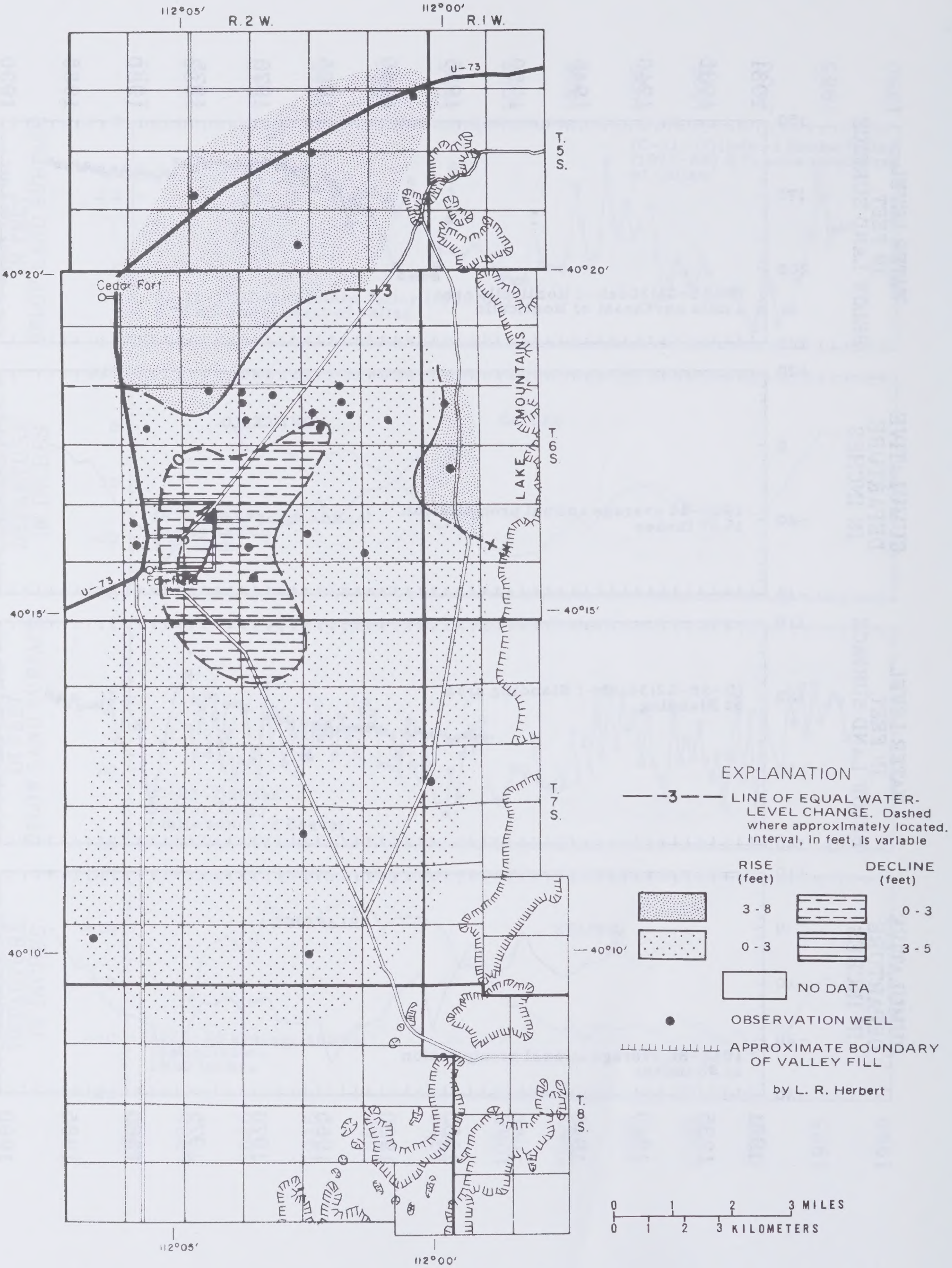


Figure 39.—Map of Cedar Valley, Utah County, showing change of water levels from March 1986 to March 1987.

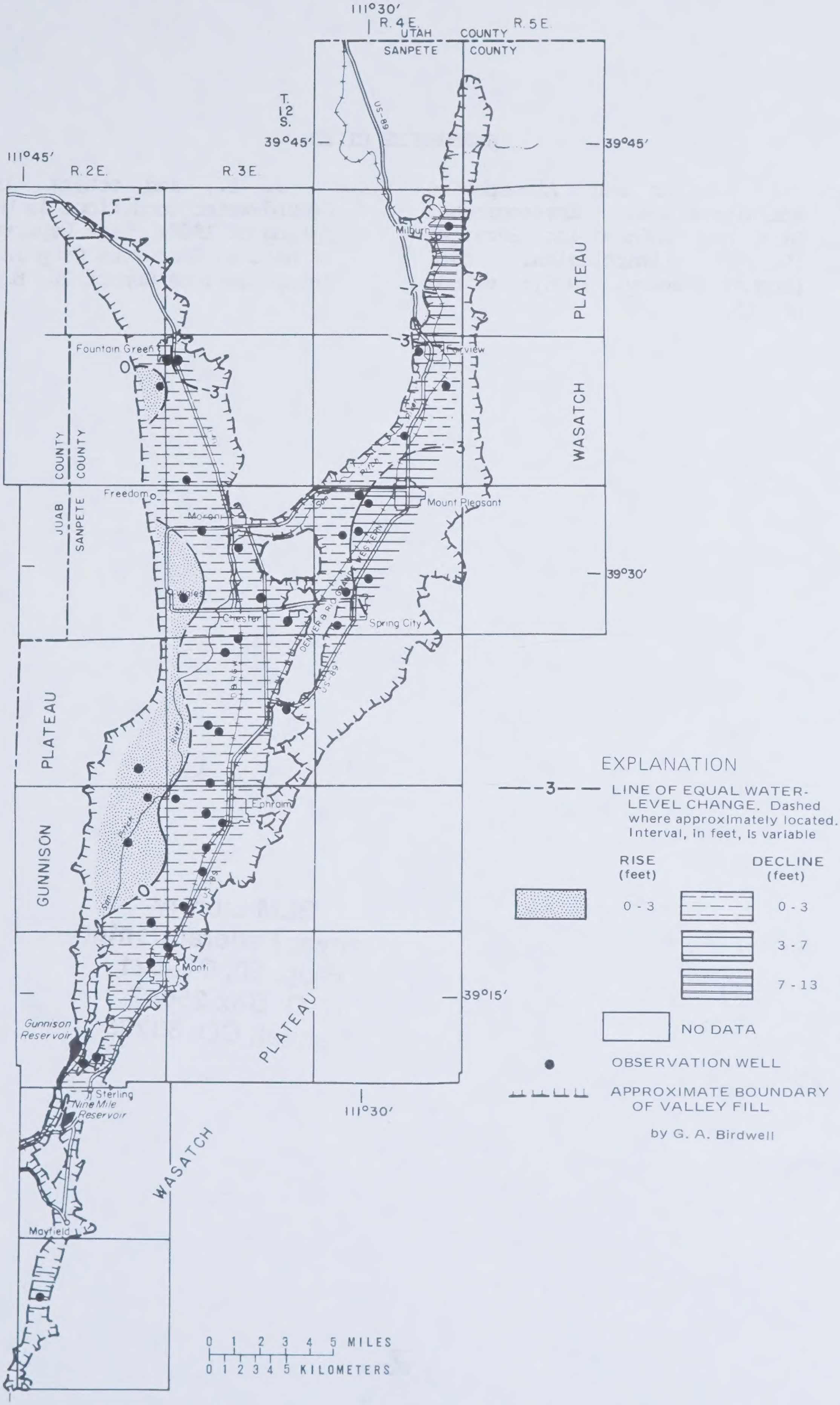


Figure 40.—Map of Sanpete Valley showing change of water levels from March 1986 to March 1987.

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